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GAHAN (A. B.). **Revision of two Genera of Chalcid-flies belonging to the Family Eupelmidae from North and South America.**—*Proc. U.S. nat. Mus.* **94** no. 3173 pp. 339–369. Washington, D.C., 1943.

Keys are given to the species of *Arachnophaga* and *Encyrtaspis*. The new species described include : *A. hirtibasis*, reared from *Brassolis astyra*, Godt., in Brazil ; *A. nocua*, a secondary parasite of *Estigmene acraea*, Dru., in Texas, the actual host probably being a species of *Apanteles* ; *Arachnophaga costalis*, reared from cocoons of *Macrocentrus* sp. infesting *Cydia* (*Grapholitha*) *molesta*, Busck, in New Jersey and Maryland, and from a pupa of *C. molesta* in Maryland ; and *A. frontalis*, of which the host records include *C. molesta* and a species of *Macrocentrus* parasitic on it in New Jersey, and *Macrocentrus* sp., the egg cluster of a spider, a Chrysopid cocoon, an unidentified Ichneumonid cocoon, *Thyridopteryx meadi*, Edw., and *Anarsia lineatella*, Zell., in other States.

The host from which Girault reared *Arachnophaga* (*Anastatus*) *aureicorpus*, Gir., in Texas has been found to be a Lepidopterous pupa and not a Syrphid puparium [*cf. R.A.E.*, A **5** 10], and an additional host record for *Encyrtaspis* (*Tineobius*) *californicus*, Ashm. [**22** 157] is *Rhyacionia* (*Evetria*) sp. on *Pinus ponderosa* in New Mexico.

SOYER (D.). **La "rosette" de l'arachide. Recherches sur les vecteurs possibles de la maladie.**—*Publ. Inst. Étude agron. Congo belge* Sér. sci. no. 21, 23 pp., 4 pls. (2 col.), 1 fig., 13 refs. Brussels, 1939. [Recd. 1944.]

The author describes the symptoms of the rosette disease of ground-nuts [*Arachis hypogaea*] in the Belgian Congo and gives a detailed account of transmission experiments. These showed that the virus [*Marmor arachidis* of Holmes] was not carried in the seed or in soil in which infected plants had grown ; it was transmitted to healthy plants by grafting and by the feeding of *Aphis laburni*, Kalt., but not by inoculation with the sap from diseased plants or by the feeding of *Bemisia tabaci*, Gennadius (*gossypiperda*, Misra & Lamba), *Empoasca facialis*, Jac., *Halticus minutus*, Reut., or *Hilda patruelis*, Stål.

In the laboratory, the developmental period of alates and apterae of *A. laburni* lasted 6–7 days, and five apterous females lived 15–27 days and produced 39–106 offspring at an average rate of 5–6 per day. In May, the winged progeny of apterae gave rise to further apterae, whereas in June, the individuals produced on the first and second days of reproduction and some of those produced on the third day were alate and the remainder apterous. The Aphids live on the lower surface of the stems, between the stipules or in the young folded leaves, and also occur on the collar of the plant. They are attacked by larvae of Coccinellids, principally *Cydonia lunata*, F., and *C.* (*Verania*) *propinqua quadrilineata*, Muls., and of the Syrphids, *Paragus borbonicus*, Macq., and *Xanthogramma aegyptium*, Wied., and also by a fungus of the genus *Entomophthora*, probably *E. aphidis* [*cf. R.A.E.*, A **24** 285]. Self-sown ground-nuts serve as a reservoir of both Aphid and virus between crops, but colonies of the Aphid were also found on *Indigofera hirsuta*, *Euphorbia hirta* and *Centrosema plumieri*. *Indigofera* and *Euphorbia* showed no evidence of disease when infested, and Aphids from them did not infect ground-nuts, but *Centrosema* was attacked by a characteristic mosaic, with deformation of the leaves. Healthy *Centrosema* plants that were infested with Aphids from diseased ground-nuts developed these symptoms in 15 days, while those infested with Aphids from healthy ground-nuts did not, but Aphids failed to transmit the virus from *Centrosema* to ground-nut.

The disease may cause the loss of 80–90 per cent. of the ground-nut crop. Where it is possible to grow two successive crops in one rainy season, the second

is the more severely attacked. Spreading plants are more susceptible than upright ones, and damage is less in dense than in open plantings [*cf. loc. cit.*]. The use of various fertilisers had no significant effect on the degree of resistance of the plants. As it would be difficult or impossible to control the Aphid by means of insecticides, and destroying infected plants did not reduce the degree of infection appreciably, it is recommended that the plants should be set as close together as possible, that two successive crops should not be grown on the same ground, that self-sown plants should be destroyed and that the most resistant varieties should be grown.

BLETON (C. A.) & FIEUZET (L.). **Sur la présence et la biologie au Maroc, d'*Atherigona soccata*, Rondani, diptère parasite du sorgho cultivé.**—*Bull. Soc. Hist. nat. Afr. N.* **34** no. 1–6 pp. 112–117, 7 refs. Algiers, 1943.

Descriptions are given of all stages of *Atherigona soccata*, Rond., which was first observed in Morocco in October 1938 on sorghum in the Fez region. It had previously been recorded from Italy only. Sorghum is a very important crop in Morocco, where it is extensively grown, but the yield is often seriously reduced by damage, particularly to the young plants, caused by Anthomyiids of the genus *Atherigona* accompanied by early generations of *Sesamia vuteria*, Stoll (*nonagrioides*, Lef.). Notes on the food-plants of various species of *Atherigona* in different parts of the world are given from the literature. In Morocco, *A. quadripunctata*, Rossi (*varia*, Mg.) has been found on sorghum and maize.

A. soccata also attacks *Sorghum halepense*, *Cynodon dactylon* and probably other grasses. The adults feed on nectar and the honey-dew of Aphids on sorghum. Pairing takes place 24–48 hours after emergence, and the eggs are laid singly under the leaves. The larvae hatch in 6–8 days and migrate to the main stem, which they enter at the level of the ligule. In a few hours, they reach the base of the plant collar, where they cut through the main stem and feed on the young, sappy tissues. The main stem becomes etiolated and dry, and the plant tillers abundantly. Some of the shoots may escape injury, but sometimes all are attacked. The continual mutilation of the tissues and the flowing sap contaminated with larval excreta produce excellent conditions for the development of bacteria that contribute to the destruction of the plant. The larval stage lasts 30–40 days and the pupal stage, which is usually passed in the soil, 30 days in winter and 40–60 in summer. There are four overlapping generations in the Fez district, and larvae, pupae and adults may frequently be seen at the same time. The four periods of adult abundance are 21st to 24th October, 12th to 15th March, 14th to 25th May and 24th to 26th June.

Suggested control measures are deep ploughing followed by frequent surface cultivation to destroy or expose the pupae, burning of stubble to destroy the minority of individuals that pupate in the stems, destruction of wild food-plants if possible, sowing of seed thickly and in rows, and frequent manuring. The larvae are parasitised by the Ichneumonids, *Diplazon* (*Homocidus*) *bizonarius*, Grav., and *Phygadeuon* sp., and a Calliceratid of the genus *Trichosteresis*. In its life-history and the damage it causes, *A. soccata* resembles *Hylemyia* (*Chortophila*) *sepia*, Mg., a pest of wheat in Morocco [*R.A.E.*, A **27** 124]. *Elachiptera scrobiculata*, Strobl (*trapezina*, Corti) and *E. bimaculata*, Lw., have the same seasonal rhythm as *A. soccata* and are frequently associated with it in sorghum but do negligible damage.

WILSON (G. F.) & GREEN (D. E.). **Observations on two Raspberry Troubles.**—*J. R. hort. Soc.* **69** pt. 3 pp. 79–86, 1 pl., 1 fig., 13 refs. London, 1944.

In the first part of this paper, Wilson gives an account, based on observations and the literature, of the bionomics of *Thomasiniana theobaldi*, Barnes, a serious

outbreak of which occurred in raspberry plantations at Wisley in Surrey in 1943. This Cecidomyiid should not be confused with *Lasioptera rubi*, Heeg., which produces walnut-shaped galls of various sizes on the stems of raspberry and blackberry. It only occasionally becomes of serious importance when climatic and environmental factors are favourable, and has been present in small numbers at East Malling (Kent) for several years. It appears to be associated with the fungus (*Leptosphaeria coniothyrium*) that causes the cane blight disease of raspberry. Larvae were recently found by A. M. Massee to occur only on canes already attacked by the fungus and in which the rind had split [*cf.* *R.A.E.*, A **29** 283] ; dying-back of the canes resulting from heavy feeding by the larvae is accelerated by the invasion of the injured tissues by the fungus. Injury is serious only when the larvae are numerous enough to cause excessive branching of the canes. The larvae beneath the rind are easily detected in June, owing to their reddish colour, but later generations shelter beneath the peeling rind. H. F. Barnes considers it unlikely that the females can oviposit in undamaged shoots, but states that eggs are readily deposited in naturally-occurring or artificially-made slits.

There were three generations at Wisley in 1943, when some overlapping occurred, but other workers have recorded two [*loc. cit.*] or only one, and the number probably depends on climatic and local factors. The peaks of larval infestation occurred on 11th June, 16th July and 9th August. The larvae pupate just below the surface of the soil or in the mulch at the base of the canes ; all unparasitised larvae leave the canes to pupate, but parasitised larvae pupate beneath the peeling rind. Barnes reared an unidentified Hymenopterous parasite from this Cecidomyiid in 1925, and 100 per cent. mortality occurred among larvae overwintering on canes collected from two districts. At Wisley, numerous pupae were found in the mulch of farmyard manure round the base of the canes during the latter part of June, the latter part of July, and from the middle of August. Larvae found on wild blackberry at Wisley in July 1943 are considered by Barnes to be *Thomasiniana* sp., almost certainly *T. theobaldi*. They occurred only on bushes in damp and sheltered situations. Previous investigators reported that only one or a few varieties of raspberry were susceptible to attack, but all those at Wisley in 1943 were infested, although they varied in susceptibility.

In experiments on control, flake naphthalene applied to the rows at the rate of 4 oz. per yard run of row on 5th August and forked, hoed or watered in was effective in destroying the stages in the soil. This treatment is especially recommended for use in October and early November, when all larvae will have entered the soil except those that are parasitised. A spray of 1 fl. oz. nicotine (96 per cent.) and 1 lb. soft soap in 10 gals. water applied to the canes on 11th June at a pressure of 90 lb. per sq. in. killed a high percentage of the young larvae, but later applications were ineffective, as the spray did not penetrate the hard rind of the older canes. Other recommended measures comprise burning badly-infested canes before the larvae leave them, and allowing infested canes to stand through the winter until May, so that parasites present in them may emerge.

In the second part, dealing with the cane blight disease and preliminary unsuccessful experiments on its control, Green discusses the possible relation between the fungus and *T. theobaldi*. He considers it probable that, even if very numerous, the Cecidomyiid cannot itself destroy the plants, but that by constantly damaging the surface tissues it provides a means of entry for the fungus ; other injuries commonly occur on raspberry canes, but the splitting of the epidermis caused by over-vigorous growth quickly heals, and those due to cultivation are considered to be negligible. It is therefore possible that the disease can be controlled by eliminating the Cecidomyiid and that controlling the disease may render the Cecidomyiid relatively unimportant. No serious outbreak of cane blight was reported from other localities.

Wilson (G. F.) & Green (D. E.). **A simple Calendar of Control Measures against Vegetable Pests and Diseases in Gardens and Allotments.**—*J. R. hort. Soc.* **69** pt. 4 pp. 104–111. London, 1944.

The first section of this paper contains short notes on the damage caused by soil pests that attack a wide range of crops and methods of controlling them, and the second consists of a table in which the commoner diseases and insects of vegetables in Britain are cited under the individual crops, with the signs by which attack may be recognised and methods of treatment.

Loughnane (J. B.) *Aphis rhamni* **Boyer ; its Occurrence in Ireland and its Efficiency as a Vector of Potato Viruses.**—*J. Dep. Agric. Eire* **40** no. 2 pp. 291–298, 14 refs. Dublin, 1943.

Surveys of populations of *Aphis rhamni*, Boy., on potato at various places in the centre and west of Eire in 1940 and 1941 confirmed findings in 1939 [*R.A.E.*, A **29** 329] ; it was abundant in the Athlone district, and occurred in significant numbers in neighbouring areas where seed potatoes are grown but was scarce elsewhere. The alate and apterous viviparous females and the alate and immature male of this Aphid are described, and some of its numerous food-plants in the United States [*cf.* **13** 31] are enumerated. It hibernates in the egg-stage on buckthorns (*Rhamnus* spp.) and is stated to spend the greater part of the summer on them before migrating to secondary food-plants. The primary food-plant in Eire is presumably *R. cathartica* ; it was not examined in autumn or winter, but occurs in districts in which potatoes were severely infested and is not known to be present where the Aphid was scarce or absent. The viviparous females do not appear to persist through the winter in Eire either in the field or under experiment in a glasshouse, where the author followed the life-cycle from potato to *R. cathartica* and back to potato. *Rumex*, *Plantago* and *Datura stramonium* were experimentally infested in the greenhouse, but potato was the only plant on which the Aphid was found in the field.

Tables are given showing the numbers of *A. rhamni* found per 100 leaves in crops in various districts. The averages per 100 leaves at Athlone were 130, 134 and 129 in 1939, 1940 and 1941, but the differences in numbers on crops a few miles apart in a given district were very great. This variation did not seem to depend on variety of potato, type of soil or aspect of the field, and some crops equidistant from *R. cathartica* were not equally affected.

Records of transmission of virus diseases by *A. rhamni* [**13** 31 ; **17** 249 ; **30** 268, 501] are reviewed ; D. S. Elze found it to transmit leaf-roll [*Corium solani* of Holmes] as well as potato viruses A and Y [*Marmor solani* and *M. cucumeris* var. *upsilon* of Holmes], though it failed to transmit leaf-roll in tests by K. M. Smith [**19** 459]. In experiments here described, Aphids reared on plants infected with leaf-roll and then transferred to healthy ones failed to infect any of ten plants in 1940 but infected two out of 11 in 1941. In July 1942, one experiment was made to compare the power of *Myzus persicae*, Sulz., and *A. rhamni* to transmit leaf-roll. Following the technique developed by M. A. Watson [**26** 342], the Aphids were starved for four hours before being placed separately on an infected leaf for five minutes and transferred for five days to young and vigorously growing plants. Ten healthy plants were used for each species, and five Aphids were placed on each plant. *M. persicae* infected seven and *A. rhamni* three plants. The author confirms that starvation increases the efficiency of the Aphid as a vector, and it was repeated in experiments in the transmission of virus Y by *A. rhamni*. In experiments made in 1941 and 1942, unstarved examples failed to transmit this virus but, using the starvation method in 1942, two experiments resulted in transmission to ten and five plants, respectively, out of 12.

Though *A. rhamni* can transmit virus diseases under experimental conditions, it is probable that it does not constitute a serious menace to the production

of healthy seed potatoes. It is abundant in districts where seed potatoes have been grown for many years without a noticeable increase in the incidence of virus diseases in the crops ; it does not arrive on potato till late in July, when plants have reached a resistant stage, or reach maximum numbers until mid-August ; and its tendency to remain in colonies on individual leaves reduces the risk of its being concerned in large scale virus transmission.

WILSON (F.). **The Entomological Control of St. John's Wort** (*Hypericum perforatum* **L.) with particular Reference to the Insect Enemies of the Weed in southern France.**—*Bull. Coun. sci. industr. Res. Aust.* no. 169, 87 pp., multigraph, 1 pl., 4 figs., 58 refs. Melbourne, 1943.

A detailed account is given of work done in connection with the attempt to control *Hypericum perforatum* in Australia by means of the introduction of insects that attack it in England and southern France [*cf. R.A.E.*, A **32** 64, etc.], a list of which is included. Sections deal with the distribution of *H. perforatum* and the insects that feed on it in Europe, Africa and Asia, its status in the Var district of southern France, studies on the bionomics of the insects associated with it in this district, of which five are of major and eight of minor importance, the extent to which it is controlled by these insects, and the competition between them. A further section is devoted to an account of the liberation and establishment in New Zealand of *Chrysomela* (*Chrysolina*) *hyperici*, Forst., from England, and *C.* (*C.*) *gemellata*, Rossi,* and *Agrilus hyperici*, Crtz., from France [*loc. cit.*] and a discussion of the prospects of ultimate control by means of them. In France, the eggs of *C. gemellata* are laid singly or in small groups on the leaves and stems of the food-plant. The larvae feed chiefly by night on the procumbent foliage, exhibiting a marked preference for the terminal leaves ; those that hatch as late as early summer are not able to survive, since the procumbent foliage dies early and the foliage of the flower stems is not sufficiently succulent for the larvae, though the adults feed on it. Pupation takes place in a small cell in the soil at a depth of 3–5 cm. There is one generation a year, and activity ceases only in summer, when the food-plants are desiccated. Eggs of *A. hyperici* are laid on the main flowering stem, mostly near its base. The larvae enter and tunnel in the roots, where they also overwinter and pupate in late spring of the following year.

A key to the adults of the species of *Chrysomela* (*Chrysolina*) that attack *Hypericum* in Europe is included, and a discussion of the theoretical aspects of the entomological control of weeds contains sections dealing with the risks involved in the method, the significance of different methods of feeding among the insects utilised, and a summary of the principles of weed control by insects.

NORRIS (K. R.) **Experiments with Insecticides against the Red-legged Earth Mite** (*Halotydeus destructor* (**Tucker**)).—*Bull. Coun. sci. industr. Res. Aust.* no. 171, 28 pp., 15 refs. Melbourne, 1943.

Halotydeus destructor, Tucker, is a major pest of a wide variety of vegetables in South Africa and of vegetables and pastures of subterranean clover (*Trifolium subterraneum*) in the southern part of Australia. Previous work with sprays and dusts against this mite and the allied *Penthaleus major*, Dugès, are briefly

* *C. gemellata*, Rossi, for which *Fauna Etr. Mant.* **1** 30 (1792) is here cited as the original reference, is preoccupied by *C. gemellata*, Geoffr. (1785), under which name it was erroneously recorded in recent abstracts [**31** 45 ; **32** 65]. *C. gemellata*, Geoffr., is a synonym of *C. hyperici*, Forst., and the next available name for *C. gemellata*, Rossi, is apparently *C. quadrigemina*, Suffr.—*Ed.*

reviewed, and an account is given of experiments against it in Western Australia in 1940 and 1941. Poison baits were also used in these tests, as it had been found that both mites are able to suck from the free surface of liquids, and that *H. destructor* is attracted by sugar solutions. Experiments in 1938 had shown that a solution of cane sugar and sodium fluoride was readily imbibed and lethal to the mite but also injurious to plants, and chaff moistened with this solution later proved effective in small scale tests in vegetable gardens. As a bait in solution is dispersed by rain, one from which the mites quickly obtain a lethal dose is required for use in pastures in Western Australia, as the mites are prevalent in autumn and winter when fine weather is of short duration. The success of poisoning also depends on the restless activity shown by the mites, especially when weather conditions are unfavourable for their feeding on plants or when they are mechanically disturbed, so that they come quickly into contact with the sprinkled bait. Laboratory tests on mites confined in tubes with a leaf of *Cryptostemma calendulaceum* and a filter-paper moistened with a sweetened poison solution were inconclusive owing to the natural mortality in confinement and to the mortality due to contact with the poison, but showed that sodium arsenate, sodium fluoride and sodium fluosilicate were sufficiently effective to warrant testing in the field and that honey and treacle were not attractive as alternatives to sugar.

The field experiments were conducted on mites in plots of close-cropped sward of *T. subterraneum*, *C. calendulaceum* and *Erodium botrys* with some grasses, enclosed by small metal fences painted with creosote, and the results were judged by sampling the mite populations before and a week after treatment on treated and untreated plots. Tests made in 1940, the main results of which have already been noticed [*R.A.E.*, A **31** 47], were considered inconclusive, since an abnormal drought prevailed. Eight experiments, the results of which are given in detail, were carried out in 1941 under normal weather conditions and in vegetation kept as uniform as possible. The tests of poison baits showed that sodium arsenate was a more effective poison than sodium fluoride, sodium fluosilicate or tartar emetic and that chaff was a better carrier than sawdust obtained from *Eucalyptus* ; about 99 per cent. control was given by a bait of sodium arsenate, sugar, water and chaff (1 : 10 : 40 : 30 parts by weight), distributed at the rate of about 250 lb. per acre. Baits are suitable for use in vegetable gardens, but too expensive for application to pasture land ; they involve far less labour in application than sprays or dusts, and chaff falls easily through foliage to reach mites on the ground. Of 16 sprays applied at the rate of 200 gals. per acre, the best was 1 per cent. Rhodox (a commercial preparation of lauryl thiocyanate containing emulsifiers), which gave about 85 per cent. control. Nicotine sulphate or rotenone in white-oil emulsions and nicotine sulphate with soap also caused a highly significant reduction in the number of mites, but the only spray that was more toxic was 0·5 per cent. potassium dinitro-ortho-cresylate, which destroyed both mites and plants almost completely. The best of 22 dusts, applied at the rate of 1 cwt. per acre, all contained nicotine in various forms ; they gave an average mortality of about 87 per cent. Relatively good results were obtained with dusts prepared on the day before use from equal quantities of waste tobacco leaf containing 1·42 per cent. nicotine and slaked lime. The only other effective dusts were 1 per cent. dinitro-ortho-cyclohexylphenol in walnut shell flour which gave about 80 per cent. control, but caused some scorching of vegetation in one experiment, and derris (2 per cent. rotenone), which gave 46·6 per cent.

Penthaleus major was too scarce in these tests to provide conclusive evidence of the value of poison baits against it, but they are not considered likely to control it in the field as it is less readily stimulated to restless activity than *H. destructor*. In a small laboratory test in Canberra in 1942, mortality was high among individuals confined in jars with food and a filter paper moistened with a solution of sugar and sodium arsenate.

Bell (E. L.). **New Records and new Species of Hesperiidae from Mexico (Lep. Hesp.).**—*An. Esc. nac. Cienc. biol.* **2** no. 4 pp. 455–468, 9 figs. Mexico, D.F., 1942. (With a Summary in Spanish.) [Recd. 1944.]

This paper includes the first published record of *Panoquina ocola*, Edw., from Mexico, but Dr. Dampf has informed the author that it appeared some time ago in the States of Colima and Jalisco as a pest of rice. It has been reported from sugar-cane and *Hymenachne* in Porto Rico and presumably feeds on other grasses as it has a wide distribution in America and occurs in regions where neither rice nor sugar-cane is grown.

Wishart (G.). **Note on the Establishment in Canada of imported Parasites of the Pea Moth, *Laspeyresia nigricana* Steph.**—*Canad. Ent.* **75** no. 12 pp. 237–238, 2 refs. Guelph, Ont., 1944.

The parts of Canada in which *Cydia* (*Laspeyresia*) *nigricana*, Steph., is a serious pest of peas are the Lower Fraser Valley in British Columbia, the Gaspé Peninsula in Quebec, southern New Brunswick, and the Annapolis Valley in Nova Scotia, and parasites were liberated against it in all these areas except New Brunswick during 1936–42. *Ascogaster carpocapsae*, Vier., and *Macrocentrus ancylivorus*, Rohw., which are parasites of other Tortricids in America, were released without success in 1936 and 1937, and *A. quadridentata*, Wesm., *Glypta haesitator*, Grav., and *Angitia* sp., parasites of *C. nigricana* imported from England [*R.A.E.*, A **29** 310], were released in and after 1937. Details of the numbers released and the results of examination of cocoons of the moth for parasitism are given in a table. The numbers of parasites released and cocoons examined in Quebec and Nova Scotia were both small, and no parasites were recovered there. The work was on a much more extensive scale in Nova Scotia, where many thousand cocoons of the host were examined. The parasites reared from them comprised *G. haesitator*, *A. quadridentata* and a species of *Phanerotoma*. Neither of the imported parasites was numerous, but both are apparently established, as they were found at a place where they had been released two years before. Unlike the other parasites, the species of *Angitia* was liberated in only small numbers.

Some authorities consider that *A. carpocapsae* is identical with *A. quadridentata* [*cf.* **23** 553, etc.], but H. R. Boyce has found genetical and other evidence to suggest that it is at least a distinct race or strain. He states that all recovered specimens appear to be of the strain from England, a conclusion supported by the failure to recover any *Ascogaster* until imported adults were liberated.

Pedersen (M. W.). **A Survey of biological Destruction of Cactus on Nebraska Range Land.**—*J. Amer. Soc. Agron.* **34** no. 8 pp. 769–770. Geneva, N.Y., 1942. [Recd. 1944.]

A species of *Melitara*, probably *M. dentata*, Grote [*cf. R.A.E.*, A **30** 426], was found to be destroying *Opuntia humifusa* and *O. fragilis* on range lands in the hardlands and sandhills near Valentine, Nebraska, in the summer of 1941. Observations on plots in several areas indicated that *Opuntia* occupied 0·103 per cent. of the ground surface in the sandhills and 0·144 per cent. in the hardlands; the percentages destroyed in the two habitats were 49·78 and 29·85, respectively, which indicates effective control. On two areas of pasture abandoned for some time after heavy grazing, in which the dominant grasses were *Bouteloua gracilis* and *Agropyrum smithi*, respectively, and in which *Opuntia* was abundant, the percentages destroyed were 60–75 and 80–100, but *Opuntia* was fairly prevalent and only slightly infested in several pastures of *B. gracilis* that were heavily grazed. This suggests that the Pyralid finds favourable conditions if the grasses are tall, a view supported by the fact that cacti are frequently of importance in

the hardlands, where the characteristic grasses are short, but not in the sandhills where they are long. Its activity is also probably affected by weather [*cf. loc. cit.*] as it did not attract the attention of other observers in 1938–40.

McGregor (E. A.). **Notes on the Resistance of Citrus Thrips to Tartar Emetic.**—*Calif. Citrogr.* **29** no. 3 p. 62, 8 refs. Los Angeles, Calif., 1944.

In the summer of 1942, some of the heaviest populations of *Scirtothrips citri*, Moult., yet recorded, occurred in the San Fernando Valley of California in lemon orchards that had been sprayed with tartar emetic and sugar two or three times a year. A similar failure in control was reported from central California later in the summer and had occurred in southern California in 1941 [*cf. R.A.E.*, A **31** 209, 411]. Laboratory tests showed that stocks raised from thrips collected in the San Fernando orchards were very resistant to sprays of tarter emetic and sugar and fed readily on the deposits from them. In order to discover whether quantities of tartar emetic lethal to the thrips can be absorbed through the lower surface of the leaves, enough of a tartar-emetic solution to leave a residue equivalent to that left by two normal applications of spray was applied over a period of five days to cloth pads in contact with the lower surface of lemon leaves. On the third day, larvae from an unresistant stock were placed on the upper surface of the leaves in glass cells that prevented them from coming into contact with the tartar emetic unless it was absorbed. A few of the larvae were dead on the fifth day, only 4·3 per cent. were alive by the ninth, and none pupated. The leaves were still living, but were slightly bleached along the veins. Tartar-emetic sprays were first used in the San Fernando Valley in 1939, and 30 generations of thrips are estimated to have developed when resistance was first noticed there. It is considered probable that if tartar emetic is absorbed into the trees, its presence in the leaves continued to eliminate the less resistant individuals throughout the year. As it has been shown that *S. citri* thrives on a diet of sugar and young *Citrus* leaves [**30** 524], the sugar in the spray residues evidently encouraged the building up of large populations, which the low mortality caused by the tartar emetic was unable to prevent.

Boyce (A. M.). **Gesarol, a promising agricultural Insecticide.**—*Calif. Citrogr.* **29** no. 3 pp. 76–77. Los Angeles, Calif., 1944.

Gesarol and Neocide are proprietary insecticides in which the toxic ingredient is 2,2-bis (parachlorphenyl)-1,1,1-trichlorethane. This chemical is also known as dichlor-diphenyl-trichlorethane, and the abbreviation DDT has apparently been officially adopted for it in the United States and Great Britain. It is also known as GNB (Gesarol Neocide base) and, when manufactured in the United States, as GNB-A, and these names have the advantage of avoiding confusion with DD, a designation applied to a proprietary mixture of dichlorpropylene and dichlorpropane [*R.A.E.*, A **31** 360]. DDT has been found effective against insects of medical importance [*cf.* B **32** 39] and has also shown promise in preliminary tests against pests of crops, including several that attack *Citrus* in California. It is toxic to many species at relatively low concentrations, remains effective for a long time, is not appreciably affected by sunlight, is not injurious to many plants, and is not soluble in water, though it dissolves in other solvents, including petroleum oil.

In laboratory tests by D. L. Lindgren, the inclusion of DDT in petroleum oils against *Aonidiella aurantii*, Mask., on *Citrus* resulted in increased mortality of mature females and prevented the young crawlers from settling and developing on the fruits for 50 days after the application, when the fruits were discarded

owing to decay. Tests in progress gave indications of even longer periods of protection from young Coccids. Sprays containing DDT dissolved in volatile solvents did not destroy the adult females, but prevented the young crawlers from settling and developing for at least 45 days, and suspensions of it in water inhibited the development of more than 95 per cent. for 33 days. This property appeared to be as potent at the end of the experiments, which were all terminated owing to the drying or decay of the fruits, as at the beginning. The deposit on the fruits appears to be very resistant to removal by means of tap-water or brushing. After some treatments, the newly-deposited crawlers were killed before emerging from the covering of the parent Coccid.

Promising results with dusts and sprays containing DDT were obtained against *Scirtothrips citri*, Moult., on *Citrus* in field tests by C. O. Persing [*cf.* **32** 219], and against *Heliothrips haemorrhoidalis*, Bch., on orange in the laboratory, and sprays containing it also showed promise against *Eriophyes sheldoni*, Ewing (citrus bud mite) in laboratory tests by R. B. Korsmeier.

Lewis (H. C.). **Injury to *Citrus* by *Tenuipalpus* Mites.**—*Calif. Citrogr.* **29** no. 4 p. 87, 1 fig. Los Angeles, Calif., 1944.

Damage to lemons by mites of the genus *Tenuipalpus* was observed in a small grove at Porterville in south-western California in the autumn of 1942, and 25 per cent. of the fruits from part of it were scarred during 1943. The injury ranged from a scab-like brownish scar, irregular in outline, to a light silvering on the exposed side of the fruit, frequently extending to the extremity furthest from the stalk. Tender wood and fruit stems showed a darkened scarred area ; leaf injury was present but unimportant. Specimens of the mites were examined by E. A. McGregor and found to resemble *T. bioculatus*, McG., which occurs on ornamental privet in various parts of the United States. Surveys of *Citrus* in other districts of south-western California revealed a relatively rare occurrence of similar mites, usually at the extremity of the fruit furthest from the stalk. Another closely related species, *T. californicus*, Banks, was originally described from *Citrus* in San Bernardino county in 1904. Mites of this genus have long been established in *Citrus*-growing areas of California, where they may be native but have rarely caused commercial injury. Infestations in 1936 and 1938 were controlled by the application of sulphur dust and oil sprays, respectively. It is thought that treatments usually practised against insects on *Citrus* have been effective in controlling mites, and that the damage here recorded was due to the absence of any treatment since the grove was planted in 1924, the lack of predators and the favourable site.

Cox (A. J.). **Terminology of Insecticides, Fungicides and other economic Poisons.**—*J. econ. Ent.* **36** no. 6 pp. 813–821. Menasha, Wis., 1943.

The author emphasises the importance of the correct use of technical terms for insecticides, fungicides and other economic poisons, pointing out that much of the value of some investigations has been lost through ambiguity in terminology, gives definitions of a number of commonly used words and discusses ambiguities due to inadequacy of language and others that are caused by inaccurate shortening of cumbersome names. He also gives examples of misleading terms in the nomenclature of insecticides and illustrates the desirability of avoiding superlatives in describing products and the necessity for invariability in their brand names. He concludes that technical language requires clear, precise and adequate expression and that correct terminology for economic poisons is not only of importance to users and manufacturers, but also an aid to entomologists, plant pathologists and chemists.

Essig (E. O.), Hoskins (W. M.), Linsley (E. G.), Michelbacher (A. E.) & Smith (R. F.). **A Report on the Penetration of packaging Materials by Insects.**—*J. econ. Ent.* **36** no. 6 pp. 822–829, 3 figs., 11 refs. Menasha, Wis., 1943.

In view of the present necessity for storing large quantities of dried, dehydrated and cured foods for considerable periods, the difficulty of obtaining suitable packing materials, irregularities in the cleaning of warehouses and the trucks and boats used for transport, and the danger of insect infestation during protracted voyages or in tropical climates, colonies of 32 species of insects that attack stored products were established and tests were made of their ability to penetrate different packing materials. The general rearing technique is described ; the tests of resistance to penetration were carried out by the exposure of small packages or flat sheets of various materials to one or several species, and similar exposure of commercial packages and of small bags or flat sheets of paper towelling impregnated with wax containing chemicals tested for repellency.

Great variation in the ability of these insects to penetrate packing materials was observed ; *Tenebroides mauritanicus*, L., was the most successful, adults of *Rhyzopertha dominica*, F., were rather effective, and even those of *Calandra* (*Sitophilus*) *granaria*, L., were able to penetrate numerous materials. Adults of *Sitodrepa* (*Stegobium*) *panicea*, L., adults and larvae of *Aphanotus destructor*, Uytt., and *Tribolium* spp. and larvae of *Ephestia* spp. and *Plodia interpunctella*, Hb., appeared to be poor penetrators, and adults of *Oryzaephilus surinamensis*, L., were unsuccessful.

It is concluded that insects with a propensity for boring are usually the best penetrators of packing materials, and at least one stage of each of the common pests of stored food, with the exception of *O. surinamensis*, was able to penetrate some of the materials tested, penetration of materials permeable to odours being apparently favoured by the presence of food with some species. The most promising type of material tested was a heavy cardboard carton double-dipped in a thermoplastic material, and the more promising transparent cellulose materials included such products as Thermophane A and Cellophane 600, though these were only relatively more resistant to penetration than most light-weight materials tested. None of the commercially used metal-substitutes was strictly insect-proof ; tests with an abrasive paper were incomplete. Among the multiwall bags, the Bemis bag was the most promising, but this was readily penetrated by *Tenebroides mauritanicus* ; laminated Kraft-asphalt-leadfoil-cellophane bags showed little resistance to insect penetration. Eight out of about 40 possible repellents prevented penetration for 21 days, but the repellent effect of most of them, especially phenol derivatives, was obscured by their toxicity to the insects. The authors consider that manufacturing techniques that will produce uniform containers without roughened spots, creases, folds and similar areas, where insects penetrate most easily, are needed, and that repellents offer a possible solution to the problem.

Linsley (E. G.) & Michelbacher (A. E.). **A Report on Insect Infestation of stored Grain in California.**—*J. econ. Ent.* **36** no. 6 pp. 829–831, 1 fig., 4 refs. Menasha, Wis., 1943.

The results are given of a survey of 128 infested granaries in 97 localities grouped in four main areas in California. In the Sacramento Valley, the order of abundance of the primary insect pests, which attack whole grain at normal moisture contents prevailing in storage, was *Calandra* (*Sitophilus*) *granaria*, L., *Sitotroga cerealella*, Ol., *C.* (*S.*) *oryzae*, L., and *Rhyzopertha dominica*, F., though *R. dominica* appears to be increasing in numbers and may eventually become more important than *C. oryzae*. In the San Joaquin Valley, *C. oryzae* is more important, being more destructive than *C. granaria* in the south, and *R. dominica*

and *S. cerealella* are rather rare. *C. granaria* was fairly abundant and *C. oryzae* rarely important in the coastal counties, where *S. cerealella* was scarce and *R. dominica* was not encountered. In the southern interior area, *C. oryzae* was most important; *R. dominica* and *S. cerealella* were common in some parts. *C. granaria* is the most important pest of whole grain in the State, though *C. oryzae* is more abundant in the south.

Of the secondary pests, which frequent granaries, but rarely attack whole grain at the normal moisture content and are usually associated with the primary pests, *Oryzaephilus surinamensis*, L., *Tribolium confusum*, Duv., and *T. castaneum*, Hbst., were common and almost equally widespread; *Laemophloeus minutus*, Ol. (*pusillus*, Schönh.) and *L. ferrugineus*, Steph., were rather less common. *T. castaneum* and *L. minutus* were more abundant in the south than in the north. *Plodia interpunctella*, Hb., and species of *Ephestia* were fairly common, but not very destructive. *Aphomia gularis*, Zell., and *Corcyra cephalonica*, Staint., occurred only in the southern interior region.

Many minor or incidental species are associated with grain in California, but practically all of these are indicators of insanitary conditions and not themselves injurious. A table is given showing for each area the total number of infested granaries, and the number in which each of the 52 species of insects taken was found.

Rockwood (L. P.) & Reeher (M. M.). **Forecasting Outbreaks of the Pea Aphid on Fall-sown annual Legumes in the Pacific Northwest.**—*J. econ. Ent.* **36** no. 6 pp. 832–837, 1 graph, 2 refs. Menasha, Wis., 1943.

A study of weather records and field notes made in western Oregon over a period of 26 years showed winter temperatures to be a basis for forecasting widespread spring outbreaks of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) on autumn-sown annual leguminous crops (winter field peas and vetches), since such outbreaks arise from viviparae that overwinter on these plants [*cf. R.A.E.*, A **31** 108; **32** 255]. Spring migration from lucerne or Scotch broom [*Cytisus scoparius*] has not been a factor of importance. Outbreaks did not occur when the minimum temperature for the winter fell below 15°F., when the mean temperature for any period of 7–8 days was 31°F. or below or when the lowest monthly mean temperature was 37°F. or below. High temperatures and rainfall in September, resulting in the presence of suitable food-plants early in autumn, increase the likelihood of large spring populations, and heavy rainfall at critical periods in the spring tends to reduce them by stimulating fungous disease (usually due to *Entomophthora aphidis*), but these are secondary to the factor of winter temperature.

In eastern Oregon and Washington, where much lucerne is grown and the Aphids overwinter on it in the egg stage, more rainfall than usual in September and the absence of frosts severe enough to kill back the plants in October and most of November increase the danger of its being seriously infested by permitting the development of heavy autumn populations, which deposit large numbers of eggs from about 15th October to the end of November.

Rockwood (L. P.) & Chamberlin (T. R.). **The Western Spotted Cucumber Beetle as a Pest of Forage Crops in the Pacific Northwest.**—*J. econ. Ent.* **36** no. 6 pp. 837–842, 8 refs. Menasha, Wis., 1943.

This information on *Diabrotica undecimpunctata*, Mannh., was collected over a period of 26 years in Oregon, where the overwintered adults cause severe damage to seedling clover just after the plants are up, and the larvae are sometimes injurious to lucerne and maize. There is one generation in the year over most of the State, but a very small second one may occur in certain areas in the south-west. The beetles seek shelter late in autumn and often congregate in

certain definite spots. They become active at temperatures near 50°F., sometimes as early as January or February, but probably do not migrate by flight until the temperature approaches 60°, first feeding on succulent weeds near their winter quarters and then moving to seedling clover, often in large bands. When weed seedlings become abundant, the beetles scatter more and clover is damaged less. They are commonly found on lucerne, vetches and field peas in April. The females may lay over 1,000 eggs, chiefly from March to May. These are deposited beneath but near the surface of the soil, probably wherever the beetles are feeding, in clusters of 4–5 and hatch in 8–22 days. The larvae feed on the roots of leguminous crops, grasses and various weeds and mature in about three weeks ; they develop on maize roots in the field and have been reared on wheat seedlings in the laboratory. In the laboratory, the prepupal and pupal stages lasted 14 and 7 days and the adults remained in the soil for 9 days before emerging, the total period from egg to active adult being 50–75 days. In a field of vetch and oats, eggs were found on 28th April, third-stage larvae 2–4 ins. below the surface on 22nd May, pupal cells in the upper 2 ins. of soil on 6th June and adults on 16th June. Emergence often begins in June, and newly emerged adults are most common in July. They feed on succulent vegetation, fruits, pollen and flowers, including red clover blossoms. Mating was observed in August, September and October ; males predominated in the field until autumn, but most of them died before winter.

Populations are reduced by deficient rainfall in spring and by extremely low winter temperatures. The Tachinid parasite, *Celatoria diabroticae*, Shim., may exert considerable control of the adults. Parasitised beetles were first observed in July and increased steadily in numbers until April. A considerable percentage of the adults may be parasitised by unidentified Mermithids, which sterilise the female and eventually kill them ; the two parasites sometimes occur in one host, and the combined parasitism sometimes exceeds 50 per cent. in March and April, so that the majority of the overwintered females may not be able to reproduce. A Staphylinid was found to have eaten several beetles in a group overwintering under plantain. *Beauveria globulifera* often kills many beetles in their winter quarters and also in the fields in autumn and spring ; more than 30 per cent. of the females collected in early spring are sometimes killed by this fungus within two weeks.

When floods had caused the accumulation of large numbers of beetles in the débris along fences, spraying with distillate oil and burning it gave good control, as did dusting with ground derris containing 1 per cent. rotenone, even at temperatures of 50°F. or less. Destroying the beetles during winter or when they are attacking seedling clover is difficult, as the winter groups are seldom found and the clover is attacked for a very short time. Damage by the adults to clover seedlings could be avoided by sowing in late May and early June, and damage by the larvae to lucerne seedlings and maize by late sowing in land that has been ploughed and kept free of weeds during the spring.

EICHMANN (R. D.). **Commercial Pea Warehouse Tests of Fumigants used against the Pea Weevil in the Palouse Region.**—*J. econ. Ent.* **36** no. 6 pp. 843–849, 1 fig. Menasha, Wis., 1943.

The following is based on the author's summary and conclusions. An account is given of an investigation on fumigation for the control of the pea Bruchid [*Bruchus pisorum*, L.] as commercially practised in the Palouse region of Washington, which is the largest area in which dried peas are produced in the United States. In this region, fumigation is conducted at temperatures far below those generally recommended in fumigating practice. Hydrocyanic acid discoids proved effective in vault fumigations at the rate of 20 oz. HCN per 1,000 cu. ft. for exposures of 12–15 hours at mean temperatures as low as 35°F. As used in bin fumigation, they did not prove satisfactory. Liquid HCN at 28 oz. per 1,000

cu. ft. in vaults proved satisfactory with mean temperatures of 30–40°F., for exposures of 30–126 hours, but not at 16°F. for 36 hours. Methyl bromide at 28 oz. per 1,000 cu. ft. for 17 hours at a mean temperature of 58°F. was a satisfactory vault fumigant, but at mean temperatures below 50°F. and as a bin fumigant it was unsatisfactory. Chloropicrin was effective as a vault fumigant at a mean temperature of 12°F. with a dosage of 3 lb. per 1,000 cu. ft. and an exposure of 30 hours. Apparently the dosage can be decreased about 4 oz. per 1,000 cu. ft. for each rise of 10°F. in temperature. As a bin fumigant under nearly optimum conditions, it also proved satisfactory.

The use of circulating fans with HCN or methyl bromide should improve results. Fans do not seem to be needed with chloropicrin. False floors also should improve results with HCN. These tests are too few to give more than indications, but they provide some information on low-temperature fumigation not previously available and a working basis for subsequent fumigation, whether commercial or experimental.

Eichmann (R. D.). **Asparagus Miner really not a Pest.**—*J. econ. Ent.* **36** no. 6 pp. 849–852, 7 refs. Menasha, Wis., 1943.

An account is given of the bionomics of the asparagus miner, *Agromyza simplex*, Lw. [*cf. R.A.E.*, A **29** 642], which has been found to be of no economic importance in Washington [*cf.* **31** 93]. In other regions, it has been accused of causing yellowing, wilting and dying conditions in asparagus, but this damage has recently been attributed to *Fusarium oxysporum* in eastern Washington. In addition, the Agromyzid has been suspected of opening an avenue of entry for the fungus, but its importance in this respect is slight compared with plant injuries caused by cultivation and harvesting.

Elmore (J. C.) & Campbell (R. E.). **Aphid Increase and Plant Injury following the Use of Calcium Arsenate on Peppers.**—*J. econ. Ent.* **36** no. 6 pp. 853–856, 4 refs. Menasha, Wis., 1943.

In 1928, *Myzus persicae*, Sulz., caused serious damage in California to peppers [*Capsicum*] that were dusted with calcium arsenate for the control of *Anthonomus eugenii*, Cano, and heavy infestations also developed in plots to which much road dust drifted. Calcium arsenate has since been used on peppers without causing serious Aphid infestations in some seasons, but its use in 1939–42 usually resulted in marked increase in Aphid abundance and subsequent plant injury. In 1941, derris was added to calcium arsenate and to cryolite [*cf. R.A.E.*, A **31** 104] to prevent the development of the Aphids; it was effective in experimental plots, and there was no material increase of Aphids in commercial fields treated with derris and cryolite, but a considerable increase, resulting in severe plant injury and defoliation, in those treated with calcium arsenate, with or without derris. In 1942, dusts of calcium arsenate (undiluted) and cryolite in talc (50 and 70 per cent. sodium fluoaluminate) alone and in combination with derris, pyrethrum or free nicotine [*cf.* **31** 436] to give 0·5 per cent. rotenone, 0·1 per cent. total pyrethrins or 1 per cent. nicotine, were applied seven times at weekly intervals from the time when the first pods began to set, and again 10 or 16 days after the last application to protect unusually late pods; the amount per acre increased from approximately 15 lb. in the first application to 20 lb. in the last. Calcium arsenate and the stronger cryolite dust were about equally effective against *A. eugenii* and both significantly more effective than the weaker cryolite. Aphids were significantly more abundant in all plots treated with calcium arsenate than in those treated with cryolite; the aphicides caused no significant decrease in Aphid populations when added to cryolite, but caused reductions when added to calcium arsenate, though these were not sufficient

to prevent serious Aphid infestations. All calcium arsenate treatments caused severe plant injury resulting in defoliation and shrivelled pods, which reduced the yields.

It is concluded that a marked increase in Aphid populations is likely to follow the use of calcium arsenate and that the combined effect of calcium arsenate and Aphids causes injury to peppers.

HASTINGS (E.) & PEPPER (J. H.). **Studies on Body Fluids of seven Orthopterans, their pH, buffering Capacity, and Effect on Solubility of fractionated Insecticides.**—*J. econ. Ent.* **36** no. 6 pp. 857–864, 4 graphs, 12 refs. Menasha, Wis., 1943.

The following is based on the authors' summary. The normal pH of the regurgitated digestive juices and blood sera of *Melanoplus mexicanus*, Sauss., *M. bivittatus*, Say, *M. differentialis*, Thos., *M. packardi*, Scud., *Dissosteira carolina*, L., and *Brachystola magna*, Giraud, were determined. Those of the digestive juices fell within the pH range of 5·2–5·8 and those of the blood sera between pH 6·8 and 7·2. Titration curves were obtained, and the buffering capacities were determined from them. All the juices were poorly buffered at their normal reaction and for a range of approximately 1·5 pH units on either side of this value; the blood was very poorly buffered both at and in the vicinity of its normal pH.

The solubilities of fractionated samples of arsenious oxide, sodium arsenite and sodium fluosilicate were studied in distilled water and in the digestive juices of *Anabrus simplex*, Hald., *B. magna* and *M. bivittatus*. With distilled water, in every case the solubility decreased as the particle size increased. In the digestive juices the same general trend was observed, but it was much less pronounced. The solubilities of arsenious oxide and sodium fluosilicate were considerably less in the digestive juices than in distilled water. Commercial Paris green was more than 50 per cent. more soluble and air-float Paris green more than 85 per cent. more soluble in the digestive juices of *B. magna* than in distilled water. Commercial lead arsenate showed the same trend, but the differences were relatively small.

SCHOPP (R.), EIDE (P. M.) & DOUCETTE (C. F.). **Experiments for Field Control of the Narcissus Bulb Fly.**—*J. econ. Ent.* **36** no. 6 pp. 864–867, 1 ref. Menasha, Wis., 1943.

Since the normal time for digging narcissus bulbs in the north-western United States is 4–6 weeks after the larvae of *Merodon* (*Lampetia*) *equestris*, F., begin feeding in them, treatment after digging does not prevent a considerable amount of damage, and investigations on measures to prevent actual infestation of the bulbs were therefore carried out. Preliminary tests of hydrated lime [*cf. R.A.E.*, A **23** 285] in 1936 gave contradictory results. In tests with a number of sprays and dusts in small field plots, begun in 1938, the most promising were W.S.C. dynamite, an inverted emulsion of lead arsenate and mineral oil [*cf.* **25** 652], which gave 81 per cent. control, and 5 per cent. mineral oil emulsion, which gave 76 per cent. In further tests the "dynamite" formula gave 62–71 per cent. control when complete, 44 per cent. when the lead arsenate was omitted and the oil used at a concentration of 1 per cent., 30 per cent. when the oil was omitted, and 52 per cent. when the triethanolamine and oleic acid were omitted. When the ingredients were tested separately, mineral oil emulsified with Vatsol OS [a sodium alkyl naphthalene sulphonate] gave 58 per cent. control, but triethanolamine with oleic acid was not significantly effective and lead arsenate resulted in increased infestation. These results indicate that the effectiveness is associated primarily with the oil. Varying the proportions of lead arsenate in the "dynamite" formula from 0 to 6 lb. per 100

U.S. gals. had little effect on control, but sprays containing 0·5, 1 and 2 per cent. oil gave 20, 56 and 61 per cent. less infestation than one without oil, the last two reductions being significant. Reductions of 45, 55 and 81 per cent. in infestation, all of which were highly significant, were obtained in three narcissus plantings treated on a semi-commercial scale with a 1 per cent. emulsion of light summer spray oil. Cubé in a dust (0·5 per cent. rotenone) gave 50 per cent. control in one test, but in further tests in which it was applied in various dusts (0·5–1 per cent. rotenone) and sprays (rotenone 1 : 5,000), it was not appreciably effective. Hydrated lime impregnated with dichlorethyl ether gave 54 per cent. control, but an equal quantity of the ether in water (12 cc. per U.S. gal.) was ineffective. Refined naphthalene flakes gave significant control (48–69 per cent.) when applied at 1, 1½ and 2 lb. per 100 ft. of row, with no significant difference between treatments. Tests on potted bulbs in a greenhouse indicated that the effect of naphthalene is not necessarily due to its repellent action against ovipositing females, as it is lethal to eggs and newly hatched larvae; it is effective for at least ten days. A number of other sprays and dusts, including a suspension of calomel [mercurous chloride] and a solution of mercuric chloride, also gave significant control and are considered to merit further investigation. The tolerance of the plants to the favourable materials was satisfactory.

YUST (H. R.). **Productivity of the California Red Scale on Lemon Fruits.**—*J. econ. Ent.* **36** no. 6 pp. 868–872, 2 graphs, 3 refs. Menasha, Wis., 1943.

The following is substantially the author's summary. The productivity of *Aonidiella aurantii*, Mask., was studied in a lemon grove near Corona, California, from the spring of 1935 until the summer of 1936. Productivity records were obtained for 194 scales on lemon fruits and were based on the number of progeny settled.

The study included four groups of scales that began to reproduce at different times during the year. The average length of the reproductive period ranged from 64·5 days for those that began in the spring and early summer to 154·3 days for those that began in the late summer and autumn. The minimum reproductive period was seven days and the maximum 287 days. The average number of progeny that settled per scale ranged from 65·6 for scales that began to reproduce in the winter to 158·5 for those that began in mid-summer. The maximum number of progeny counted from one mother scale was 300. Scales began to reproduce in each month throughout the year. Many of those that began late in the summer lived until the spring of the following year, giving birth to crawlers in two seasons. During the summer, an average of 35·2 female progeny per reproducing scale developed to the mature stage. The maximum was 85.

The productivity records of 56 scales reared in the laboratory at a constant temperature of 77°F. substantiated the high production records in the field.

YUST (H. R.), NELSON (H. D.) & BUSBEY (R. L.). **The Influence of repeated Fumigation with HCN on the Susceptibility of the California Red Scale.**—*J. econ. Ent.* **36** no. 6 pp. 872–874, 4 refs. Menasha, Wis., 1943.

Californian strains of *Aonidiella aurantii*, Mask., that are, respectively, resistant and susceptible to hydrocyanic acid gas have been reared in the laboratory since 1935 [*cf. R.A.E.*, A **32** 203]. Stock taken from the resistant strain in 1939 was given seven fumigations with hydrocyanic acid gas in eight generations, after which the survivors were divided into two groups, one of which was given seven additional fumigations in seven generations. The survivors of two fumigations were appreciably and the survivors of seven significantly

more difficult to kill than the resistant strain, and the survivors of 13 or 14 fumigations were significantly more resistant than the survivors of seven. In another series of experiments, two fumigations in successive generations had little effect on the resistance of a stock of very resistant scales, but six treatments definitely increased it.

Scales collected in 1940 in the grove from which the laboratory susceptible strain had been obtained were reared in two groups for six generations. One group was not fumigated, and the other was fumigated in each generation. Members of the first group proved more resistant to fumigation than the susceptible laboratory strain, and members of the second had become more resistant than the resistant strain after the fourth fumigation.

It should not be concluded that the resistance of field populations increases as rapidly as that of laboratory stocks, as field fumigations are less frequent and less efficient, and some of the females that survive may have been fertilised by non-resistant males before fumigation.

YUST (H. R.), BUSBEY (R. L.) & NELSON (H. D.). **Influence of decreasing, constant, and increasing Concentrations on Results of Fumigation of the California Red Scale with HCN.**—*J. econ. Ent.* **36** no. 6 pp. 875–878, 2 graphs, 7 refs. Menasha, Wis., 1943.

The following is based largely on the authors' summary. Resistant Californian red scales (*Aonidiella aurantii*, Mask.) on lemon fruits were fumigated in the laboratory with hydrocyanic acid gas to compare the effectiveness of decreasing, constant and increasing concentrations, with and without prefumigation exposures that produced protective stupefaction [*cf. R.A.E.*, A **31** 100, etc.]. In a given test, the average of the concentrations tested was approximately constant. Without protective stupefaction, a better kill was obtained with decreasing than with constant concentrations and with constant than with increasing ones. With prefumigation, the differences in the effectiveness of the several types of concentration were practically eliminated.

Since scales in the field are almost always subjected to stupefying dosages of gas escaping through the tents after the first series of trees is fumigated, these results suggest that high average concentrations are essential in practice, but that particularly high initial concentrations are unnecessary.

ALLEN (H. W.) & BRUNSON (M. H.). **The Effect of Proximity to Apple on the Extent of Oriental Fruit Moth Injury in Peach Orchards.**—*J. econ. Ent.* **36** no. 6 pp. 879–882, 4 refs. Menasha, Wis., 1943.

The following is based on the authors' summary and conclusions. A study was made of extensive data accumulated in New Jersey and other eastern States on the density of populations of *Cydia* (*Grapholitha*) *molesta*, Busck, in peach orchards and the amount of injury to ripe fruit, to determine whether peaches are generally more severely injured by this moth in orchards adjoining or interplanted with bearing apple trees than in isolated blocks of peach trees. There is considerable evidence that moths that emerge from the overwintered generation produced in apples in late summer and autumn may migrate from apple trees to adjoining peach orchards in sufficient numbers to increase the population of the first generation in such orchards to a density above the average. There was also a tendency towards a somewhat greater proportion of injury to the fruit in peach orchards adjacent to apples or interplanted with them than in others, but this tendency was highly variable, and from the available data it was not possible to demonstrate consistently significant differences [*cf. R.A.E.*, A **25** 757–758].

Because of the tendency towards greater infestation by *C. molesta*, the planting of peach orchards adjacent to apple should be avoided if isolated sites equally

satisfactory in other respects are available. On the other hand, the increases in injury to peaches resulting from proximity to bearing apples have not generally been large enough to warrant recommendations against the planting of peach in such situations, if sites not exposed to the migration of the moths are unavailable.

YOTHERS (M. A.), CARLSON (F. W.) & CASSIL (C. C.). **Tests of 4,6-dinitro-o-cresol Emulsion against overwintering Codling Moth Larvae.**—*J. econ. Ent.* **36** no. 6 pp. 882–884, 2 refs. Menasha, Wis., 1943.

Experiments with dormant sprays containing dinitro-o-cresol to kill larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., hibernating in their cocoons on the trunks and scaffold limbs of apple trees [*R.A.E.*, A **31** 112] were continued in Washington in 1942 and 1943. The dinitro-o-cresol used was that diversely known as 3,5- or 4,6-dinitro-o-cresol. All quantities given for the mixtures are per 100 U.S. gals. spray. In view of the laboratory tests [*loc. cit.*], a spray containing 2 lb. dinitro-o-cresol, 10 U.S. gals. stove oil and 3 lb. sodium oleate, with no penetrant (wetting agent), was used in the orchard in 1942, but it killed only 62 per cent. of the larvae. Even so, only 8 per cent. of the apples from the treated block of 145 trees were infested at harvest time, as compared with 18 per cent. on untreated trees.

In large-scale orchard tests in 1943, a spray of 4 lb. dinitro-o-cresol, 10 U.S. gals. stove oil, 4 lb. sodium lauryl sulphate and a penetrant, consisting of 1·5 U.S. gals. each of ethylene glycol monobutyl ether and trichlorethylene killed 94 per cent. of the larvae in two orchards, and this spray and one of 3 lb. dinitro-o-cresol, 15 U.S. gals. stove oil, 6 oz. sodium lauryl sulphate and 3·78 gm. ferric chloride killed 86 and 80 per cent. in a third orchard, where spraying conditions were less favourable. These sprays were applied between 25th March and 6th April. The second mixture cost only half as much as the first; the ferric chloride aided in breaking the emulsion so that the stove oil was free to dissolve the wax in the cocoons. In tests of several mixtures containing dinitro-o-cresol, stove oil and sodium lauryl sulphate, with and without the penetrant, applied to small numbers of trees on 6th–7th April, mixtures of 3 lb. cresol, 6 oz. sulphate and 15–20 U.S. gals. oil without the penetrant and one containing only 2 lb. cresol with 4 lb. sulphate, 10 U.S. gals. oil and the penetrant killed a smaller proportion of the larvae than those containing the penetrant and 3 lb. cresol with 4 lb. sulphate and 15 U.S. gals. oil or 4 lb. cresol with 4 lb sulphate and 10 U.S. gals. oil, between which the differences were small and probably not significant.

The cocoons are usually more readily wet by a spray that is directed up under the rough bark than by one from above, especially on the scaffold branches, and those not reached by the upward spray are wet by the excess draining down the tree. Some fruit buds are killed and leaf buds retarded on twigs in the lower centre of the trees, especially if the spray is applied after the period when the trees are strictly dormant, but this injury is of little importance, as it merely eliminates a few apples that do not colour well [*cf.* **31** 269].

COLLINS (D. L.) & MACHADO (W.). **Reactions of the Codling Moth to artificial Light and the Use of Light Traps in its Control.**—*J. econ. Ent.* **36** no. 6 pp. 885–893, 20 refs. Menasha, Wis., 1943.

In this paper, the principal published information on the responses of *Cydia* (*Carpocapsa*) *pomonella*, L., to light and the use of light-traps in control experiments in apple orchards in the United States is collated, together with some hitherto unpublished information from experiments carried out in New York in 1927–40.

The following is substantially the authors' summary. The codling moth has long been known to be attracted to lights, and several investigators have studied the possibilities of using light-traps for its control. It was found to be more strongly attracted to blue and violet light than to other lights, especially to the strong blue and violet bands of the mercury spectrum. The same bands also appear to stimulate oviposition. The photochemical reactions taking place in the eyes, which have a morphological manifestation in the movements of the iris-pigment, proceed more quickly under the influence of blue and violet light, a fact that may account for the greater attractiveness of that region of the spectrum.

The electrocuting type of trap has generally been found to be the most satisfactory. The largest catches are obtained when the traps are hung in each tree close to the top. To obtain measurable reduction in injury, it has been found necessary to have a trap in every tree. Traps containing an attractive bait as well as a light capture more moths than bait or light alone. When both bait-traps and light-traps are operated in the same trees, the benefit is greater than with either alone. Light-traps have usually given better results than bait-traps. The number of females captured by the light-traps has represented from 28 to 45 per cent., usually 40–45 per cent., of the total catch. This was consistently lower than the percentages in bait-traps, but the actual number of females caught was usually higher in the light-traps. Temperature was an important factor in light trapping, since the moth does not fly readily at temperatures below 60°F.

Light-traps have been found to reduce damage to the fruit by about as much as two cover sprays of lead arsenate. No investigator, however, has recommended that light-traps should form a part of a practical control programme. Any practical application must await more detailed knowledge of the habits and behaviour of the moths and the development of new light sources and auxiliary equipment.

Questel (D. D.) & Irons (F.). **Insecticidal Treatment of Market Sweet Corn with high-clearance Boom Equipment for Control of the European Corn Borer.**—*J. econ. Ent.* **36** no. 6 pp. 893–896, 1 fig. Menasha, Wis., 1943.

The author describes investigations carried out in commercial fields of sweet maize in Ohio to determine the practicability of applying derris by means of boom sprayers for the control of *Pyrausta nubilalis*, Hb. The nozzles were adapted to deliver a solid cone of comparatively coarse spray, and were arranged to give a restricted band of spray, which resulted in thorough treatment of the areas where the larvae feed. Applications of 4 lb. ground derris and 5·3 oz. Arescap (monobutyl phenylphenol sodium monosulphonate) as a wetting agent per 100 U.S. gals. water, four times at intervals of five days from the earliest hatching of the first generation, reduced the numbers of larvae in the plants and in the ears by 83·6 and 72·8 per cent. over two acres in 1940 and by 87–91 and 85–91 per cent. over six acres in 1941. Treatment caused an increase in the number of marketable ears per acre, in the percentage of uninfested ears and in the sale price per dozen ears. In 1942, sprays of 4 lb. derris (4 per cent. rotenone) per 100 U.S. gals. water with the wetting agent (1 : 2,500) were applied at the rate of 150 U.S. gals. per acre per application four times at intervals of five days or two and three times at intervals of seven days, and a dust of derris mixed with bentonite clay to contain 1 per cent. rotenone was applied at 40 lb. per acre per application four times at intervals of five days. These treatments reduced the numbers of larvae by 76–86, 46–82, 60–81 and 67–82 per cent. in the plants and by 73–86, 31–81, 57–87 and 64–82 per cent. in the ears. The spray applied four times gave better borer reduction in the plants than any other treatment, but three applications appeared to give equal or slightly better control in the ears in some varieties,

probably owing to more favourable timing of one or more of the applications. Two applications of spray were at least as effective as four applications of dust. Spray treatments provided greater numbers of uninfested ears with 40 per cent. less derris than the dust treatments. Much higher proportions of uninfested ears and much larger total yields of marketable ears were harvested from the sprayed plots than from any untreated plots. It is considered that where borer populations are high, it should be profitable to treat market sweet maize for the control of *P. nubilalis* with high-clearance power-operated equipment such as that described in this paper.

DUNNAM (E. W.), CLARK (J. C.) & CALHOUN (S. L.). **Effect of the Removal of Squares on Yield of Upland Cotton.**—*J. econ. Ent.* **36** no. 6 pp. 896–900, 3 refs. Menasha, Wis., 1943.

Although Hamner found that the removal of all squares soon after they were visible for six successive weeks early in the season caused no significant reduction in the yield of upland cotton in Mississippi [*R.A.E.*, A **30** 547] and other investigators found that early defloration increased the yield in other varieties in Arizona, removing all squares large enough to attract boll weevils [*Anthonomus grandis*, Boh.] at weekly intervals for 1–9 weeks, and removing 10–50 per cent. of such squares weekly for 7–11 weeks reduced the yield of upland cotton in Mississippi in 1939–41. In spite of the fact that more squares were produced and removed on plants dusted with calcium arsenate than on plants that were not dusted, and that as many squares developed after defruiting was stopped, less seed cotton was produced in dusted than in undusted plots. As the damage caused by boll weevils was of little importance in most years, this reduction can be mainly attributed to the increased populations of Aphids [*Aphis gossypii*, Glov.] that developed after the application of calcium arsenate.

YOUNG (M. T.), GARRISON (G. L.) & GAINES (R. C.). **Calcium Arsenate with and without Cube and Nicotine for Control of the Boll Weevil and the Cotton Aphid at Tallulah, La., in 1942.**—*J. econ. Ent.* **36** no. 6 pp. 901–903, 2 graphs, 2 refs. Menasha, Wis., 1943.

In 1942, cubé (5 per cent. rotenone, 19·9 per cent. total extractives), nicotine sulphate (40 per cent. nicotine) and a commercial nicotine dust containing 10 per cent. free nicotine were added to calcium arsenate dusts (40·5 per cent. total arsenic pentoxide, 8·7 per cent. water-soluble arsenic pentoxide) that were applied to cotton in Louisiana at various times of day for the control of *Anthonomus grandis*, Boh., in order to prevent increases in the populations of *Aphis gossypii*, Glov. [*cf. R.A.E.*, A **31** 186]. Applications were made at intervals of 4–5 days, and each plot received 4–5 effective ones. All the treatments were equally effective in controlling *Anthonomus*, infestation by which was light, and no treatment gave a significant increase in yield. Late-afternoon applications of calcium arsenate alone for weevil control and of a mixture of tobacco dust, lime and nicotine sulphate (3 per cent nicotine) as needed for Aphid control gave the best control of the Aphids and the highest yield, and late-afternoon applications of calcium arsenate with nicotine sulphate to give 1 per cent. nicotine controlled the Aphid and was the only other treatment that resulted in a yield somewhat higher than that from the untreated plot ; this treatment was insignificantly more effective than similar applications of calcium arsenate containing 1 per cent. free nicotine. Alternate applications of calcium arsenate alone and with nicotine sulphate (2 per cent, nicotine) gave an insignificantly lower Aphid count and higher yield than similar treatment with a dust containing half as much nicotine sulphate. Applications of calcium arsenate and cubé (0·5 per cent. rotenone) were more effective against the Aphid and gave an insignificantly higher yield when made in the late

afternoon than when made in the early morning. Applications of calcium arsenate alone were followed by the highest Aphid infestation and a significantly lower yield than was obtained from the untreated plot.

In another experiment, a higher infestation of Aphids developed when calcium arsenate alone was applied early in the morning than when it was applied at midday or late in the afternoon. Alternate applications of calcium arsenate alone and with nicotine sulphate to give 2 per cent. nicotine in the early morning, at midday and in late afternoon resulted in insignificantly higher yields than comparable alternate applications of calcium arsenate alone and with 2 per cent. free nicotine, but the early-morning and late-afternoon applications of both mixtures were more effective against the Aphids than the midday treatments, the Aphid populations being the same as those on the untreated plot after the former treatments and significantly higher after the latter. The yields following applications of calcium arsenate alone were consistently lower than the yield of the untreated plot.

PLUMMER (C. C.), MONK (J. W.) & SHAW (J. G.). **Field Studies on Insecticides for the Control of the Mexican Fruitfly.**—*J. econ. Ent.* **36** no. 6 pp. 904–911, 9 refs. Menasha, Wis., 1943.

Field experiments were carried out in northern Mexico to determine the effectiveness against *Anastrepha ludens*, Lw., on *Citrus* of bait-sprays of 4 lb. copper sucrate per 100 U.S. gals. water or 20 lb. granulated sugar and 4 lb. tartar emetic or sodium fluosilicate per 100 U.S. gals. The copper sucrate, the formula for which is probably $Cu(OH)_2C_{12}H_{22}O_{11}$, was prepared from commercial grades of cupric sulphate, sodium hydroxide and sucrose and weighed as dry material. It was partly soluble at the dilution used. The sprays were applied as a mist, usually once every three weeks unless rainfall in excess of 0·2 ins. made more frequent applications necessary, between 4th January and 26th April 1939. The fly populations were measured over a period of time before and after application of the insecticide by means of traps containing a solution of crude brown sugar, hung among the foliage ; analysis of variance of the data obtained before spraying showed that the populations in plots of South Washington navel oranges and Valencia oranges varied significantly, and the results were corrected accordingly. It was found that the tartar emetic and copper sucrate reduced the fly populations by 41·2 and 1·6 per cent., respectively, and that 6·8 per cent. more flies were captured in the sodium-fluosilicate plots than in untreated ones. It is considered that under conditions in this area, a reduction of 41·2 per cent. in the numbers of flies would not reduce commercial damage appreciably in seasons in which the fly population is large enough to cause commercial damage.

Applications of mist sprays containing small amounts of tartar emetic for more than four seasons caused no injury to the fruit and foliage of *Citrus* [*cf. R.A.E.*, A **26** 325], and applications to Marsh seedless grapefruit for two successive seasons and to Valencia oranges for three did not affect the quality of the fruit.

SMITH (F. F.) & GOODHUE (L. D.). **Toxicity of Nicotine Aerosols to the Green Peach Aphid under Greenhouse Conditions.**—*J. econ. Ent.* **36** no. 6 pp. 911–914, 7 refs. Menasha, Wis., 1943.

The liquid-gas solvent method of producing aerosols [*R.A.E.*, A **31** 349] can be used to apply nicotine in greenhouses, without the loss inevitable in applications by combustion and without risk of fire when dichlordifluoromethane is the solvent. The results are given of greenhouse tests to determine the toxicity of such aerosols to *Myzus persicae*, Sulz., on collard plants and to compare the results of this method with those obtained by burning a commercial preparation

containing 14 per cent. nicotine and approximately 20 per cent. sodium nitrate and 65 per cent. tobacco stems. The aerosol containers were hung about two feet above the bench and rotated during the period of discharge (2–3 minutes). Treatments were begun at 4.30 p.m., and the ventilators were kept closed until 8 a.m. the next day.

The nicotine was applied at dosages of 1·39, 0·7 and 0·35 gm. per 1,000 cu. ft. in the aerosols and 1·27 and 0·64 gm. from the combustible powder. No fan was used for some tests with the dosages of 1·39 and 1·27 gm., but the others were applied with a fan operating for five minutes. The average mortality percentages for the aerosols were : 97·8 for 1·39 gm. at 64·3–65·3°F. without the fan ; 99·2 for the same dosage at 68·6–74° with the fan ; 81·1 for 0·7 gm. at 65·2–72·9° ; and 79·2 for 0·35 gm. at 65–68·8°. Those for the combustible powder at the higher rate (half the standard dosage) were 63·5 without the fan at 64·3–65·3°, and 68·5 with it at 68·6–74°. Mortalities for the lower rate were very variable, ranging from 3·4 to 97 per cent. in different experiments with no evident relation to temperature. Where the leaves overlapped with an intervening space of less than half an inch, many Aphids were unaffected by either treatment, and the fan did not cause the insecticide to reach these Aphids. It is concluded that only about half as much nicotine is required when it is dispersed in dichlordifluoromethane as when it is applied as a constituent of a combustible powder, as the burning of the latter either destroys nearly 50 per cent. of the nicotine or fails to evolve it in an effective form. Also, the greater variation in the results with the burning mixture suggests that the amount of active nicotine produced varies. The addition of 2 gm. diglycol laurate to 100 gm. of a solution of 0·82 gm. nicotine in dichlordifluoromethane, as a wetting agent, did not affect its efficiency.

Lee (C. S.) & Hansberry (R.). **Toxicity Studies of some Chinese Plants.**—*J. econ. Ent.* **36** no. 6 pp. 915–921, 4 refs. Menasha, Wis., 1943.

The following is based on the authors' summary. Tests of dusts, water suspensions and extracts prepared from 35 species of Chinese plants reputed to have insecticidal, piscicidal or medicinal value were carried out, using *Aphis rumicis*, L., and larvae of *Epilachna varivestis*, Muls., and *Bombyx mori*, L., as test insects. The results are shown in detail in a table. Preparations of 18 species killed at least 50 per cent. of one or more of the insects, those of *Pachyrhizus erosus* and *Millettia pachycarpa* acting as both contact and stomach insecticides and the remainder as stomach insecticides only. Seeds of *P. erosus* [*cf. R.A.E.*, A **31** 502] seem to offer the greatest promise of commercial value, because of the annual habit of the plant and the fact that they could be gathered in considerable quantity in Latin America, where it is cultivated for the food value of its tubers. The seeds of *M. pachycarpa* have considerable insecticidal value [*cf.* **30** 528], and this plant seems to merit experimental propagation for insecticidal purposes. No planting stock is known to be available in the western hemisphere. Other species that seem to have sufficient promise to justify further work are *Delphinium delavayi*, *Tripterygium forrestii*, *Phytolacca acinosa*, three species of *Aconitum* and unidentified species of *Celastrus* and *Palaquium*.

Flanders (S. E.). **Indirect Hyperparasitism and Observations on three Species of indirect Hyperparasites.**—*J. econ. Ent.* **36** no. 6 pp. 921–926, 17 refs. Menasha, Wis., 1943.

The author discusses the importance of indirect hyperparasitism, which is defined as the parasitism of primary parasites inside their hosts and is considered to be less important than direct hyperparasitism or the attack of primary parasites outside their hosts [*cf. R.A.E.*, A **5** 16]. He points out that the

influence of hyperparasites on the effectiveness of parasites used in biological control is impossible to evaluate without establishing one in a region where primary parasites keep a pest under control, but considers it probable that indigenous hyperparasites have in some cases prevented or at least delayed the establishment of introduced primary parasites. The generally indiscriminate host relations of hyperparasites enhance this danger, but seem to indicate that an introduced species will only rarely do more than replace a native species through competition. In support of the view that occasional establishment of introduced hyperparasites has not had serious consequences, he cites evidence from which he concludes that the reduction in efficiency of *Metaphycus lounsburyi*, How., in controlling *Saissetia oleae*, Bern., on *Citrus* in California is due to its tendency to bring about even development of the broods of scale [*cf.* **31** 315], rather than, as was formerly supposed, to the action of the introduced hyperparasite, *Quaylea whittieri*, Gir., and other indirect hyperparasites that increased rapidly after its introduction [*cf.* **12** 81 ; **16** 435] ; and that the Encyrtid, *Saronotum americanum*, Perkins, which was found to be a hyperparasite of *Perkinsiella saccharicida*, Kirk., after its introduction into Hawaii from Ohio in 1903, became relatively scarce, while the primary parasites that it attacked (*Haplogonatopus vitiensis*, Perkins, and *Pseudogonatopus hospes*, Perkins) effected a higher percentage of parasitism, when *Perkinsiella* had been controlled by the introduction of *Cyrtorrhinus mundulus*, Bredd., in 1920.

Accounts, based largely on the literature, are given of the bionomics of *Eusemion californicum*, Comp., which is a secondary parasite of Coccids such as *S. oleae* and *Coccus hesperidum*, L., and is probably indigenous in California, occurring chiefly in the cool coastal regions ; *Q. whittieri*, recorded as a secondary parasite of *S. nigra*, Nietn., *S. coffeae*, Wlk. (*hemisphaerica*, Targ.), *C. viridis*, Green, and *Asterolecanium pustulans*, Ckll., which is probably a native of Australia and appears to be limited to the coastal areas in California ; and *Myiocnema comperei*, Ashm., which appears to be a tertiary parasite of Coccids and attacks *Q. whittieri*.

WILLIAMSON (A. L.). **Two foreign Bean Pod Borers discovered in Texas.**—*J. econ. Ent.* **36** no. 6 pp. 936–937, 2 refs. Menasha, Wis., 1943.

Moths reared from larvae attacking the pods of green string beans in the lower Rio Grande Valley of Texas were identified as *Epinotia opposita*, Heinr., and *Maruca testulalis*, Geyer, neither of which had previously been recorded from the continental United States. The larvae of *Epinotia* were found in several localities in December 1941 and April and December 1942. Those of *Maruca* occurred in one field in June 1943, when no other green string beans were growing in the Valley, and were not found on lima beans about 25 and 50 miles away or on *Crotalaria incana*, which is a food-plant in Porto Rico [*cf. R.A.E.*, A **29** 345].

SULLIVAN (W. N.), SCHECHTER (M. S.) & HALLER (H. L.). **Insecticidal Tests with *Phellodendron amurense* Extractive and several of its Fractions.**—*J. econ. Ent.* **36** no. 6 pp. 937–938, 4 refs. Menasha, Wis., 1943.

A petroleum-ether extract of the fruit of *Phellodendron amurense* dissolved in acetone solution gave 62 per cent. mortality of Culicine mosquito larvae in 18 hours, as compared with 6 per cent. given by derris (5·2 per cent. rotenone), when both were used at a concentration of 1 : 100,000. Chemical fractionation of the extract was carried out, and the scheme used and the relative toxicity to adults of *Musca domestica*, L., of each fraction when dissolved in acetone at a concentration of 50 mg. per ml. are shown in a table ; some of the fractions were much more toxic than the original extract, the most effective being a molecular distillate obtained at 100–150°C. Certain fractions were also tested against

larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., but these tests did not give such sharply differentiated results. In other tests against house-flies, the extract killed an average of about 50 per cent. when dissolved in acetone at a concentration of 50 mg. per ml., but the kill varied considerably with different samples of fruit and also with its degree of maturity. When dissolved in a refined high-boiling kerosene, the extract gave negligible kill [*cf. R.A.E.*, A **32** 189], and since this is the solvent in most commercial fly-sprays, the use of extracts of *P. amurense* in such preparations does not appear to be practical.

A solution of a petroleum-ether extract of *P. lavallei* in acetone, at a concentration of 50 mg. per ml., was about as toxic to house-flies as one of an extract of *P. amurense* [*cf.* **32** 190].

DAVIDSON (R. H.). **The relative Effectiveness of some Corn Earworm Control Measures in Sweet Corn.**—*J. econ. Ent.* **36** no. 6 p. 938, 6 refs. Menasha, Wis., 1943.

In order to determine the comparative efficiency of different methods of controlling the corn earworm [*Heliothis armigera*, Hb.] in sweet maize in Ohio, 6 cc. mineral oil containing 0·2 per cent. pyrethrins [*cf. R.A.E.*, A **31** 267] or 1 gm. styrene dibromide per 100 cc. oil [*cf.* **31** 496] was injected into the ears of some plants and the silks of others were clipped [*cf.* **31** 509], on 30th August 1943, approximately six days after silking. The percentages of undamaged ears when the crop was harvested on 13th September were 81·6, 91·7 and 61, respectively, for the three treatments and 21·3 for untreated ears, indicating that treatment with styrene dibromide is the most effective.

CARTER (R. H.), MANN (H. D.) & SMITH (C. M.). **The chemical Nature of Copper-Arsenic Insecticides.**—*J. econ. Ent.* **36** no. 6 pp. 941–942, 9 refs. Menasha, Wis., 1943.

The authors discuss the chemical composition of Paris green and some of its homologues, copper (cupric) arsenites and basic copper (cupric) arsenates, which are used as insecticides, and give a table showing their percentage contents of cupric oxide, and total and water-soluble arsenic trioxide and the molecular ratio of cupric oxide to arsenic trioxide and mean particle diameter.

MAYER (E. L.) & PHILLIPS (A. M.). **Di-n-butylamine as a Fumigant.**—*J. econ. Ent.* **36** no. 6 pp. 942–943, 4 refs. Menasha, Wis., 1943.

In small-scale fumigation tests, di-n-butylamine was more effective than carbon bisulphide against adults of *Calandra* (*Sitophilus*) *oryzae*, L., and *Bruchus* (*Callosobruchus*) *maculatus*, F., when allowed to evaporate from filter paper in the absence of grain, the percentage mortalities after exposure for 24 hours being 4, 69, 87 and 100 for *Calandra* at dosages of 0·0013, 0·0026, 0·0053 and 0·0079 cc. per litre and 38, 71, 97 and 100 for *Bruchus* at 0·00026, 0·00079, 0·00132 and 0·00212 cc. per litre from the former, and 8, 93 and 100 for *Calandra* at 0·0053, 0·0159 and 0·0239 cc. per litre and 13, 74 and 100 for *Bruchus* at 0·0053, 0·0106 and 0·0159 cc. per litre from the latter. The minimum lethal doses of 0·0079 and 0·00212 cc. di-n-butylamine and 0·0239 and 0·0159 cc. carbon bisulphide per litre represent 0·38, 0·101, 1·87 and 1·24 lb., respectively, per 1,000 cu. ft. In further tests in which the weevils were buried in maize, wheat or maize meal, di-n-butylamine was about as effective as carbon bisulphide in penetrating between the large maize grains, but did not penetrate so well between the smaller wheat grains and showed very poor penetration in maize meal, in which weevils buried ½ in. deep were all killed and deeper ones were unaffected. Carbon bisulphide gave complete mortality at a depth of four inches in maize meal. Since only 98·5 per cent. of a 4 cc. sample of the butylamine evaporated in 22

hours from the filter paper, a small hot-plate was used in some of these tests ; by this means, 2 cc. was completely evaporated in about five minutes, but the more rapid production of vapour had no effect on the final mortalities at the different levels. The meal turned yellow to the depth of penetration of the butylamine, but the discoloration disappeared after it had stood in an open dish for two days. Fumigation with di-n-butylamine in a saturated atmosphere had very little effect on the germination of seeds of various vegetables

BESS (H. A.). **Insect Attack and Damage to White-pine Timber after the 1938 Hurricane in New England.**—*J. For.* **42** no. 1 pp. 14–16. Washington, D.C., 1944.

A hurricane in September 1938 blew down several hundred million board feet of merchantable pine timber in the New England States, and though much of it was salvaged and stored in ponds or sawn up before it could be attacked by insects, considerable quantities remained on 1st July 1939. In many stands, large numbers of trees were broken, and these and uprooted trees were as susceptible to insect attack in spring as freshly-cut logs. Wind-thrown trees with only a few roots intact escaped injury in the spring and early summer of 1939, but were attacked to some extent by bark-beetles in August ; these trees died in the autumn but insect damage in them was slight. Many prostrate and leaning trees that were not actually uprooted remained alive for two or more years ; although overwintering populations of insects were high in 1939–40 and the supply of breeding material was limited, approximately 70 per cent. of these trees were alive and uninfested at the end of the summer of 1940. In general, living trees on sites near the damaged areas were not attacked, though in one plantation white and red pines [*Pinus strobus* and *P. resinosa*] 25 years of age were heavily infested by bark-beetles and killed.

Bark-beetles, Longicorns, Buprestids and bark weevils were sufficiently abundant in 1939 to infest practically all the susceptible timber immediately, but ambrosia beetles were relatively scarce, though they became more abundant in 1940. *Ips pini*, Say, and *I.* (*Orthotomicus*) *caelatus*, Eichh., were the most abundant bark-beetles, and *I. calligraphus*, Germ., *Dendroctonus valens*, Lec., *I.* (*Pityogenes*) *hopkinsi*, Swaine, and *Pityophthorus* sp., were abundant in a few localities. *Monochamus scutellatus*, Say, *M. titillator*, F., and *Asemum moestum*, Hald., were the common Longicorns throughout the region, the first being by far the most injurious, and *M. notatus*, Drury, was fairly abundant in one district in southern Maine. The tops of large uprooted trees that died soon after the storm were heavily infested by *M. scutellatus* in 1939, but the lower parts of the trees were marketable as late as the spring of 1941. Buprestids attacked many exposed logs and dead trees, especially the side receiving most sunlight, in 1939, but did not cause serious damage. *Hylobius pales*, Hbst., and *Pissodes approximatus*, Hopk., bred in large numbers under the bark of logs and stumps, which they did not damage, and caused much loss of pine reproduction. *H. pales* killed enormous numbers of seedlings of white pine, 6–36 ins. in height, and *P. approximatus* were also found breeding in transplanted trees 5 years of age in one plantation.

Some 60 per cent. of the logs from wind-felled trees were stored in ponds and suffered little damage from insects or wood-staining fungi, since although bark-beetles bred under the bark on the upper part of some of them, the wood was not stained. Many unsawn logs were stacked on sites some distance from the damaged area, and examinations in July and August 1939 indicated that infestation by *Monochamus* spp., and ambrosia beetles was usually very low, though infestation by *Monochamus* was higher in logs that had not been removed from the woods before insect activity had started in spring. In tests in 1939 on the value of various chemical sprays in protecting green logs stacked in areas containing wind-felled trees, the logs were cut and treated in

April and May or at the end of June, and were sawn during November and December. The ten sprays used were coal-tar creosote and kerosene, a mixture of diphenyl, toluene and fuel oil alone or with pentachlorphenol, fuel oil alone or with pentachlorphenol or monochlornaphthalene, drip oil (obtained as a by-product in the manufacture of water-gas), water-gas tar alone or with kerosene, and spent oil. None was effective against bark-beetles, though all gave some protection against borers ; in most cases, however, this did not offset the cost of treatment. Water-gas tar and the mixture of diphenyl, toluene, pentachlorphenol and fuel oil appeared to afford the best protection, but covering the stacked logs with straw and boughs or spraying with fuel oil alone gave the best results from an economic point of view.

T[ANNER] (V. M.). **The Mexican Bean Beetle, *Epilachna varivestis* Mulsant, does Damage in Utah in 1943.**—*Great Basin Naturalist* **4** no. 3–4 p. 61, 2 refs. Provo, Utah, 1943.

Epilachna varivestis, Muls., which was first recorded in Utah in 1922 [*R.A.E.*, A **17** 524], did considerable damage to beans in the Utah valley during the summer of 1943. The adults hibernate under leaves and weeds and along the banks of ditches until late spring. Few eggs are to be found before July. By mid-July the larvae are half-grown and feeding on the leaves of the beans. Pupation occurs on the lower side of the leaves. Only one generation has been noted in the Provo area.

KNOWLTON (G. F.) & MADDOCK (D. R.). **Insect Food of the Western Meadowlark.** —*Great Basin Naturalist* **4** no. 3–4 pp. 101–102. Provo, Utah, 1943.

The remains of more than 2,000 insects, many of economic importance, were recognisable in the stomachs of 172 individuals of *Sturnella neglecta* (western meadowlark) taken in Utah during 1932–42. A list is given of families, genera and species identified, showing their numbers, and a table shows the numbers of various orders in the stomachs at different times of the year.

STONE (M. W.) & HOWLAND (A. F.). **Life History of the Wireworm *Melanotus longulus* (Lec.) in Southern California.**—*Tech. Bull. U.S. Dep. Agric.* no. 858, 30 pp., 5 figs., 10 refs. Washington, D.C., 1944.

The following is almost entirely based on the authors' summary of a detailed account of investigations made in 1931–37 on the bionomics of *Melanotus longulus*, Lec., all stages of which are described. This wireworm ranks next to *Limonius californicus*, Mannh., in importance as a pest of vegetable and grain crops. The larvae destroy germinating seeds, particularly of beans, maize, melons and wheat, and also kill growing plants and damage potatoes, beet and other root crops. Counts indicated that they represent 24 per cent. of the wireworms in bean fields, the others being *L. californicus*.

Dissemination is mainly by flight ; both sexes fly strongly, especially on cool, cloudy days. In moist soil in the open, over 70 per cent. of the eggs were deposited in the top inch layer, and 18, 7 and 3 per cent. at depths of 1–2, 2–3 and 3–4 inches. The incubation period varied in the laboratory with temperature ; individual records ranged from 25 to 45 days. Of three broods of larvae reared in salve-cans [*cf.* *R.A.E.*, A **24** 31] in 1931–33 and fed on various quantities of wheat monthly, the percentages that matured in the second, third, fourth and fifth years were 45·4, 35·5, 15·8 and 2·6. None matured in the first year but one did so in the sixth. Development was more rapid in outdoor cages [*loc cit.*], probably because the temperature in spring and early summer was higher ; 92·8, 5·5 and 1·7 per cent. of the survivors of 1,066 larvae of the broods of the years 1932–1934 pupated in the second, third and fourth years.

Of the total number of larvae, 34 per cent. completed development and the rest perished, the majority by cannibalism and natural causes and a few from injuries received through handling. Larval development was accelerated by high soil temperatures and retarded by a diet of sterile lima beans [*cf.* **31** 201]. The durations of the pre-pupal and pupal stages varied with temperature but averaged 8·5 and 24·3 days, respectively, in the laboratory. The periods during which pupation occurred varied in different years from 42 to 68 days, the earliest and latest dates being 10th June and 28th September. The percentages of larvae pupating in July, August and September averaged 10, 65 and 25. In outdoor cages, pupae were recovered at depths of 6–24 inches, the majority at 9–12 inches.

The adults overwinter in the pupal cells in the soil. Collections made by sweeping lucerne or in traps consisting of loose piles of *Malva parviflora* showed that emergence in the field occurred as early as 19th March. The earliest and latest dates in the laboratory were 6th April and 1st June, and the peaks were between 13th April and 17th May, varying with temperature. Mating took place in the afternoon of the day of emergence, and more frequently on cloudy than on sunny days. The pre-oviposition period lasted 2–29 days, with an average of 10·7 days. Oviposition occurred between 15th April and 27th June in the laboratory and 19th April and 7th June in the outdoor cages and reached a peak in the second and third weeks of May. The number of eggs laid by individual females ranged from 117 to 473 in salve-can cages, where the larvae had been subjected to an excess of food, and from 31 to 303 in outdoor cages. The average oviposition periods were 40 days in the laboratory and 18 in the open. Males and females lived for averages of 22 and 37 days in the open, and of 41 and 46 days in the laboratory, the maxima being 63 and 66 days, respectively.

The only natural enemies recorded were the Carabids, *Calosoma cancellatum*, Eschscholtz, and *C. semilaeve*, Lec., which attacked the adults, and birds, which fed on larvae, pupae and adults when the fields were being ploughed.

Beckwith (C. S.). **Insects attacking Blueberry Fruit.**—*Circ. N. J. agric. Exp. Sta.* no. 472, 4 pp. New Brunswick, N.J., 1943.

The principal insects that damage the fruits of blueberry in plantations in New Jersey are the blueberry race of *Rhagoletis pomonella*, Walsh, and *Mineola vaccinii*, Ril., both of which have only one generation a year. The adults of *Rhagoletis* emerge from mid-June to 20th July, most of them between 20th June and 10th July, and their ten-day preoviposition period affords the opportunity for control. The eggs are laid under the skin of the berries and the larvae feeds on the pulp, the egg and larval stages lasting 4–8 and 16–22 days, respectively. Pupation occurs in the soil, 85 per cent. of the puparia lying within an inch of the surface. Most of the pupae give rise to adults in the following year but some do so after remaining in the soil for 2, 3, or 4 years. Seven years' experience has shown that satisfactory control is obtained by two applications from aircraft, on 30th June and 10th July, of a derris or cubé dust containing 5 per cent. rotenone [*cf. R.A.E.*, A **25** 545].

Much of the information on *Mineola vaccinii* and its control has already been noticed [**30** 119]. The treatment with pyrethrum dust (0·2 per cent. pyrethrins) applied twice from an aeroplane was repeated on a larger scale in 1941 ; the results were successful but less conclusive than in 1940, since the infestation was lighter. The cost is discussed.

Other insects that commonly attack the fruits of blueberry in the larval stage are the yellow-headed fireworm [*Peronea minuta*, Rob.], which has three generations a year and also rolls the leaves, the cherry fruit-worm [*Cydia packardi*, Zell.] and the plum curculio [*Conotrachelus nenuphar*, Hbst.]. None of them, however, has been injurious where measures against both *Mineola* and *Rhagoletis*

have been applied. The Putnam scale [*Diaspidiotus ancylus*, Putn.] sometimes spreads to the berries from the bush, and adults of the Japanese beetle [*Popillia japonica*, Newm.] destroy whole fruit-clusters as well as the leaves.

PICKETT (A. D.). **Blueberry Insects and their Control.**—*Publ. Dep. Agric. Can.* no. 754, pp. 25–27, refs. Ottawa, 1943.

The most important pest of blueberries in Canada is the fruit-fly that has been shown to be a race of *Rhagoletis pomonella*, Walsh [*cf. R.A.E.*, A **25** 471; **29** 226]. It is evidently subject to some natural control, however, as infestation was severe in 1930 and 1939, and relatively light in the intervening years and 1940. Forest fires have reduced serious infestations in many years, and the rotational burning practised every third spring in natural blueberry barrens affords a high degree of control if a sufficient area is treated to prevent invasion from outside, as it destroys the food-supply for a year. It is not completely effective, however, as reinfestation results from pupae that remain in the soil for a second winter [*cf.* preceding abstract]. In preliminary experiments on control carried out in Nova Scotia in 1941 and 1942 with dusts applied when the earliest berries turned blue and again 10–14 days later good results were obtained with mixtures of calcium arsenate and hydrated lime (1 : 3), or hydrated lime and dehydrated copper sulphate (2 : 2 : 1) and with synthetic cryolite. These dusts are given in order of increasing cost; each was applied at the rate of about 6 lb. insecticide per acre per application. Calcium arsenate alone caused injury to the plants. Promising results in 1941 and in practical work by several growers were obtained from a single application of 10 lb. lead arsenate per acre when the earliest berries turned blue. If its value is confirmed, it will avoid the need for two applications; the cost for materials is about the same as for two applications of calcium arsenate and lime. Derris or similar dusts containing rotenone can be used on cultivated blueberries, but are too expensive for blueberry barrens, as two or three applications of a dust containing 5 per cent. rotenone are made at the rate of 15–20 lb. per acre [but *cf.* **26** 333].

Pseudanthonomus validus, Dietz (currant fruit weevil) is sometimes more numerous on blueberry than *R. pomonella*, but appears to be of no importance on newly burned areas. The eggs are deposited in the calyx lobes of young green berries and hatch in late June or early July. The larva feeds on the pulp for about a month and then pupates within the berry, the pupal stage lasting 9–10 days. Both larvae and pupae may be found in early ripe berries, but most of the infested berries will have disappeared ten days later. The adults emerge in early August and feed on the berries, but seldom damage the crop. The polyphagous Geometrid, *Cingilia catenaria*, Dru., is a periodical pest of blueberry in parts of eastern Canada, where it may completely destroy foliage and fruit. A list of some of its food-plants is given [*cf.* **13** 497]. The adults are on the wing by day in September and October. The eggs are laid on the leaves of various low-growing plants and overwinter on them after they have died and fallen. The larval stage lasts from early June till late August. From limited experiments in control, arsenicals or cryolite in sprays or dusts are recommended; a single test of pyrethrum dust gave considerable success. Treatment of an area a few yards wide in the path of migrating larvae has been found effective [*cf.* **17** 82].

Periodic burning and arsenical sprays or dusts are recommended to control *Haltica* (*Altica*) *torquata*, Lec., and *Galerucella vaccinii*, Fall, which are common but not serious pests on blueberries in Canada. *G. vaccinii*, which sometimes causes damage in New England [*cf.* **13** 132], is said to feed only on low-bush plants under natural conditions, but, when tested on 83 species of plants, both larvae and adults fed on high- and low-bush blueberry plants, rejecting other food. The adults overwinter among débris near the stems of the plants and feed in spring on the expanding buds. Oviposition begins with the shedding of

the pollen and may continue for nearly two months. The larvae usually feed singly and skeletonise the leaves. No insects of great importance have appeared in the few plantations of high-bush blueberries in the Maritime Provinces, but *Hyphantria cunea*, Dru., sometimes attacks them. It can be controlled by cutting out and burning the webs in which the larvae shelter or by a rotenone dust applied as soon as the webs appear.

GORHAM (R. P.). **Insect Notes.**—*Acadian Naturalist* **1** no. 2 pp. 84–86. Fredericton, N.B., 1943.

Epilachna varivestis, Muls., was found in New Brunswick for the first time in August 1942, and surveys showed that it occurred in bean fields in a number of isolated places in four southern counties. It has been an annual pest in southern Maine since 1939. A correlation of the distribution of the infestations in New Brunswick and of new ones recorded at the same time in Maine with the meteorological records for the period when infestation must have occurred indicates that the beetles migrated from a relatively small area and travelled rather more than 100 miles to the north-east, spreading out to infest bean fields at many scattered points.

Pyrausta nubilalis, Hb., was recorded on maize in two counties in New Brunswick in 1928, but was apparently eliminated by an intensive campaign carried out over a period of three years. In 1942, however, it was more numerous than usual in the New England States and Ontario, and in August 1943 two larvae were found in a maize-stalk in a garden in Fredericton.

In late June 1943, beetles later identified as *Phyllobius oblongus*, L., were observed feeding in large numbers and mating on *Prunus nigra* in a south-eastern county; this weevil was recorded from a neighbouring county in 1928.

FAURE (J. C.). **The Phases of the Lesser Army Worm, *Laphygma exigua* (Hübn.).**—*Fmg in S. Afr.* **18** no. 203 pp. 69–78, 1 fig., 7 refs. Pretoria, 1943.

The author describes laboratory experiments at Pretoria from which he concludes that phases similar to those of locusts occur in *Laphygma exigua*, Hb. Three generations were reared from October to December 1942, at a constant temperature of about 85°F. and 60–70 per cent. relative humidity, 606 individuals in isolation and 5,674 in 39 crowds, but otherwise under identical conditions. Growing seedlings of maize were used as food for the larvae, and moist soil was provided for pupation. The egg, larval and combined prepupal and pupal stages lasted about 2, 10–11 and 6–8 days, the moths lived for approximately 8–10 days, and the first eggs were laid about 2–5 days after emergence. Larvae in or near the fifth instar were classified as phase *gregaria* (very dark in colour), *transiens* (dark grey) and *solitaria* (pale coloured), and the average percentages of the total in each group were 64·4, 27·3 and 8·3 for larvae reared in crowds and 0, 12 and 88 for those reared in isolation. Larvae reared in crowds were far more active than the others, and the activity probably led to the production of an excess of waste products, resulting in the formation of the black coloration. Attempts to intensify the phase characters by breeding *gregaria* and *solitaria* lines showed that the great majority of all larvae reared in isolation assumed the *solitaria* type of coloration and the great majority of those reared in crowds the *gregaria* type, regardless of the colour of the two previous generations. There was no clear evidence of a carrying over of phase characteristics from one generation to the next, all larvae in the first two instars being pale green, and the degree of development of *gregaria* characters in crowds depended on the density of the crowd rather than on the phase history of the parents. When 17 larvae were reared in isolation in tubes covered with black paper and closed with black cottonwool, six became black, six were

very dark and five showed no adaptation to the background colour, whereas 22 reared in isolation in tubes similarly covered with white paper did not differ from those reared in plain glass tubes. Adults from larvae that developed in crowds were slightly darker on the forewings than those from larvae kept in isolation, but the difference was not very striking, probably because excess waste products are lost during the quiescent pupal stage ; no differences were found in the size, wing-length or other structural characters of the adults, or in the sharpness of the serrated edge of the mandibles of the exuviae of fifth-stage larvae. The *gregaria* line apparently did not develop quite so rapidly as the *solitaria* line, but no conclusions could be drawn from these experiments. Two crowds reared out of doors developed coloration similar to that in crowds bred in the laboratory.

The author considers that if the parallel between phases in armyworms and in locusts is valid for other aspects besides larval coloration, the former will also be able to live permanently in the phase *solitaria* only in comparatively small areas, within which swarms will develop under conditions favourable for rapid multiplication, and will be found to migrate over long distances in the adult stage.

Apart from the phase theory, the strongest points in favour of the theory of migration are that the species cannot hibernate in any of its developmental stages and is unlikely to be able to breed continuously on the cold high veldt during winter and during dry periods in the early summer, when there is practically no green grass ; that outbreaks are first reported from the tropical and subtropical areas and later from the cooler areas ; and that the adults tend to congregate in large numbers.

FAURE (J. C.). **Phase Variation in the Army Worm,** *Laphygma exempta* **(Walk.).** —*Sci. Bull. Dep. Agric. For. S. Afr.* no. 234, [2]+17 pp., 1 col. pl., 19 refs. Pretoria, 1943.

Experiments similar to those noticed in the preceding abstract were carried out with three generations of *Laphygma exempta*, Wlk., bred between January and April 1943 from eleven individuals collected on *Cynodon*. The egg, larval and combined prepupal and pupal stages lasted about 2, 10–13 and 7–11 days, the adults lived approximately 7 days and the pre-oviposition period was 2–3 days. The larvae developed phase variation to a more striking degree than those of *L. exigua*, Hb. In the three generations, 12,385 larvae were reared in 34 crowds, and all (including the descendants of two generations reared in isolation) were classed as *gregaria* (dark coloration) when examined during the sixth instar. Of 909 reared in isolation, 1·1 per cent. were classed as *gregaria*, 36·5 per cent. as *transiens* (medium coloration) and 62·4 per cent. as *solitaria* (light coloration). As in the case of *L. exigua*, attempts to intensify phase characters by breeding in successive generations gave no clear indication of their inheritance. When 40 isolated larvae were reared in the light and 34 in darkness, 0, 30 and 70 per cent. of the former and 32·3, 55·9 and 11·8 per cent. of the latter were classified as *gregaria*, *transiens*, and *solitaria*, respectively ; and when one crowd was reared in the light and one in darkness, both consisted entirely of phase *gregaria*, but those reared in darkness were distinctly darker than the others. Larvae reared in crowds were much more active than isolated ones ; they were much less inclined to cannibalism than those of *L. exigua*. Adults from crowded or isolated larvae showed no differences in size, shape of wing or coloration that could be correlated with phase variation, and no clear evidence was obtained of any physiological difference between the phases.

The author describes searches made in Pretoria and other parts of the Transvaal in 1942–43, which resulted in the discovery of only 13 larvae, suggesting that the species does not breed permanently in the Union, and gives an account received from E. C. G. Bedford of the migration of a swarm observed at Letaba.

The moths were flying in a swarm about 300 yards wide at 8 p.m. on the 28th March 1943, were found settled in large numbers on the next night and had disappeared on 1st April. Larvae were very numerous in April and had pupated at the end of the month. Moths emerged from collected pupae between 5th and 10th May, but none could be found where the larvae had pupated, though hundreds of Hymenopterous parasites of *Laphygma* were seen. The theory that the adults migrate over long distances is supported by the occurrence of phase variation, references to migration in the literature, and the facts that outbreaks begin in the low veldt and gradually spread westwards and southwards in succeeding generations, that they occur suddenly and unexpectedly, that *L. exempta* cannot hibernate as a pupa, and that there is little food available in winter and early summer on the high veldt, while the objections to it, including the shortness of the preoviposition period and the occurrence of small outbreaks on the high veldt at the same time as larger ones on the low veldt appear to be inadequate. The author concludes that no real progress can be made in explaining the origin of serious outbreaks of *L. exempta* until its permanent breeding grounds and outbreak areas are discovered.

Similar small-scale experiments with another Noctuid, *Spodoptera abyssinia*, Gn., which often causes severe damage to lawns in South Africa, showed that larvae reared in isolation are much paler than those reared in crowds, but it is doubtful whether this indicates phase variation comparable with that of locusts and armyworms, as the factor of increased activity in crowds appears to be lacking or poorly developed. The Galerucid beetle, *Galerucella triloba*, F., which feeds on a shade tree, *Celtis kraussiana*, in Pretoria and congregates in dense masses on the lower side of large branches or on the trunk to pupate, showed no difference in coloration in the last larval instar when the larvae were reared in isolation or in crowds.

Notes by L. Chippindall on the grasses of the genus *Cynodon*, which will probably be of importance in studies of the field ecology of *L. exempta* in its outbreak centres or its permanent habitat, are appended.

Smee (C.). **Locusts** (*Nomadacris septemfasciata*, **Serv.**).—*Nyasaland agric. quart. J.* **4** no. 1 pp. 19–20. Blantyre, 1944.

Although no swarms of *Nomadacris septemfasciata*, Serv., were reported in Nyasaland between October 1943 and January 1944, fair numbers of solitary, or semi-solitary locusts were observed in tree-less areas with short grass. These may either be stragglers from passing swarms, or indicate the return of the locusts to the solitary phase. Although it is unlikely that hopper bands of any magnitude can develop from eggs laid by isolated locusts, incipient concentrations may be formed.

Smee (C.). **Two Mealy Bug Scale Insects on Tung.**—*Nyasaland agric. quart. J.* **4** no. 1 pp. 20–26, 4 figs. Blantyre, 1944.

Four years' observations on the infestation of tung [*Aleurites*] by *Pseudococcus adonidum*, L., at Zomba [*cf. R.A.E.*, A **29** 62 ; **30** 503 ; **31** 353] indicate that it will be controlled by parasites before it damages the trees seriously, but *P. perniciosus*, Newst. & Willc., which has been found on tung in both the Zomba and Cholo districts and also infests tea in Cholo and Mlanje [**30** 502, 503] may become an important pest, although it is attacked by parasites and predators. Both mealybugs occur on the leaves, shoots and fruits of tung ; they probably cause little injury to well-formed fruits, but the damage to leaf-stalks and young shoots interferes with the normal growth of the tree, and killing of large branches has been observed on trees heavily infested with *P. perniciosus*, probably after only a few months of attack. The young may be carried by wind, birds, fallen leaves or fruit, or may spread where trees are touching.

The control measures recommended comprise continuous inspection of plantations to discover the first sign of infestation ; cutting badly infested branches to about 1½–2 ft. from the main trunk or even whole trees to the main trunk and burning the cuttings ; scorching the clumps of mealybugs by means of grass torches ; or washing off the clumps with a strong jet of water, directed as close as possible to the infested shoots under high pressure.

Box (H. E.). **The *Sahlbergella* Menace to Gold Coast Cocoa.**—*Memor. Cocoa Res. Sta. Tafo* no. 9, 8 pp. Accra, 1944.

For some years, cacao in the Gold Coast has been severely injured by the swollen-shoot virus disease [*cf. R.A.E.*, A **32** 26, etc.] and by two species of *Sahlbergella* ; the latter secrete a toxin that usually kills the plant tissue within a short time after the attack and are responsible for the loss of at least 20 per cent. of the total annual production. *S. singularis*, Hagl., causes reduction in crop yields and die-back and death of mature trees, sometimes over large areas, and the presence of *S. theobroma*, Dist., which attacks and kills seedlings and the herbaceous shoots of young budded trees, makes it practically impossible to re-establish plantings killed by *S. singularis* or swollen-shoot disease. On one farm, planted with approximately 3,000 seedlings in 1938, more than 1,500 were replanted within five years, in spite of favourable conditions, expert supervision and the application of control measures, and the trees were practically leafless in September 1943.

A short account is given of the life-history of these Capsids and of their natural enemies [*cf.* next abstract]. The female lays about 50 eggs, which are embedded in the stem, pods or petioles and hatch in 14–15 days ; the complete life-cycle lasts about 5–6 weeks, and there are approximately eight overlapping generations in the year. Practical methods of control would comprise the use of resistant varieties of cacao and biological control of the insects ; proposed investigations on these are briefly discussed.

Box (H. E.). **Capsid Pests of Cocoa in West Africa. Outline of present Knowledge and proposed Lines of Research.**—*Memor. Cocoa Res. Sta. Tafo* no. 12, 11 pp. multigraph. Accra, 1943.

Of the indigenous Bryocorine Capsids that attack cacao in West Africa, the major pests in the Gold Coast are *Sahlbergella singularis*, Hagl., and *S. theobroma*, Dist. [*cf.* preceding abstract]. They kill the vegetative parts of the trees, leading to death of the affected branches and ultimately of the whole tree, particularly in regions of high rainfall, and first attracted attention in about 1909 in the Gold Coast and within the last 10–12 years in Nigeria. *S. singularis* has been known in the Belgian Congo, where it is a serious pest, and the Cameroons since the beginning of the century, but *S. theobroma* has not been recorded from these countries. In the Gold Coast, *Bryocoropsis laticollis*, Schum., which was first observed in 1938, is very abundant in parts of the Eastern and Central Provinces, but has not been found in the Western Province, Southern Ashanti or British Togoland ; there are no records of it in Nigeria. It is considered a minor pest, as it appears to damage only the pods [*cf. R.A.E.*, A **29** 492], but under experimental conditions it will attack shoots in the same manner as *Sahlbergella*. Several species of *Helopeltis* attack cacao in the Gold Coast and Nigeria ; they are essentially pests of the pods in the Gold Coast, though damage to young shoots has been noted in the Western Province, but the damage in Nigeria may be quite serious [*cf.* **29** 516]. *H. bergrothi*, Reut. [*cf.* **29** 515, 516], which was first reported as a pest of cacao in Ashanti in 1909, occurs throughout tropical Africa as far east as Tanganyika, but another, undetermined, species seems to be more generally distributed as a pod pest in the Eastern Province of the Gold Coast.

Very brief notes are given on the bionomics and field ecology of the Capsids [*cf.* **14** 570; **30** 272], and more detailed ones on alternative food-plants. *S. singularis* has been found only on certain wild species of *Cola* (not in a primitive plant association) and on the introduced plant, *Berrya ammonilla*. *S. theobroma* attacks cultivated *Citrus* and causes serious lesions on young silk cotton trees (*Ceiba pentandra*) in the cacao belt of the Gold Coast; it has not been found on *C. pentandra* in a primitive plant association, but there is evidence that it occurs on *Bombax flammeum* in primeval forest. No wild food-plants of *Bryocoropsis* are known, but several introduced plants, including avocado, have been attacked at Tafo. The only known wild food-plant of *H. bergrothi* in the Gold Coast is *Mareya spicata* in second-growth associations, and none is known for the other species of *Helopeltis*. In Nigeria, *Solanum verbascifolium* is recorded as an important alternative food-plant of *Helopeltis* and as attractive to the other Capsids attacking cacao, with the exception of *Sahlbergella*.

The nymphs and adults of *S. singularis* are parasitised by *Euphorus sahlbergellae*, Wlkn., which probably occurs throughout the range of the Capsid on cacao in the Gold Coast and has recently been found in Nigeria. It also attacks nymphs and adults of *Bryocoropsis laticollis*, and though it has not been reared from *S. theobroma*, Euphorine larvae have occasionally been dissected from the nymphs. In the Gold Coast, the degree of parasitism appears to vary inversely with the prevailing humidity, falling from about 30 per cent. during the dry season to less than 5 per cent. during the rains. Cotterell, however, found that the rate of parasitism of *S. singularis* by this Braconid was higher in Fernando Po, where the humidity is higher, than it was shown to be by the same technique in the Gold Coast [**19** 189], a point of importance if it indicates the occurrence of a biological race adapted to high humidity. *E. sahlbergellae* is itself parasitised by the Ichneumonid, *Mesochorus melanothorax*, Wlkn., which kills about 40 per cent. of the primary parasite when *S. singularis* is the host, but less than 20 per cent. in *B. laticollis*. Preliminary studies indicate that hyperparasitism is much less in dry regions such as Togoland than in the rain-forest belt of the Gold Coast; *Mesochorus* has not been recorded from Nigeria. *Encyrtus cotterelli*, Wtstn., was reared from *S. theobroma* in Ashanti over twenty years ago [**10** 527], but has not been seen since. Species of *Helopeltis* are attacked by an undescribed species of *Euphorus* in the Gold Coast. No egg parasites were found, and little is known of predators attacking Capsids on cacao [*cf.* **30** 272].

Brief notes are given on other Bryocorine Capsids in tropical Africa in view of the possibility that their parasites might adapt themselves to the species that attack cacao. There are probably at least ten other species of *Helopeltis* within the range, some of which are known to be parasitised in Nigeria and Tanganyika, and four species of *Sahlbergella* have recently been described from the Belgian Congo. *Lycidocoris mimeticus*, Reut. & Popp., and *L. modestus*, Dist., occur on Rubiaceae in the Gold Coast, the Congo and Uganda, but no parasites of this genus are known in Africa. The genus *Odoniella* appears to contain the largest number of species and have the widest distribution of the African Bryocorines; *O. apicalis*, Reut. & Popp., and *O. rubra*, Reut., are known in the Gold Coast, where they are attacked by parasites probably belonging to the genus *Euphorus*. A species of this genus, distinct from *E. sahlbergellae*, has been reared there from a nymph of *Boxia khayae*, China [*cf.* **32** 79]. Other Bryocorines found in the Gold Coast are a species of *Chamus*, which is common on *Combretum racemosum*, and two species apparently belonging to undescribed genera, one, related to *Chamus*, feeding on *Combretum*, and the other, related to *Bryocoropsis* on *Macaranga*.

Proposals are made for laboratory and field studies on the bionomics and ecology of the Capsids and their natural enemies and for further investigations on spraying, dusting and hand-picking as emergency measures of control and on biological control as a permanent alleviation.

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